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A NATIONAL STUDY OF THE AVIATION MECHANICS OCCUPATION.
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A NATIONAL SURVEY WAS UNDERTAKEN TO PROVIDE DATA FOR THE ACCOMPLISHMENT OF THREE OBJECTIVES--(1) TO INVESTIGATE THE TECHNICAL KNOWLEDGE AND MANIPULATIVE SKILLS OF AVIATION MECHANICS AS REQUIRED BY THE AVIATION INDUSTRY, (2) TO IDENTIFY A CORE CURRICULUM FOR THE TRAINING OF AVIATION MECHANICS, AND (3) TO IDENTIFY THE SCOPE OF TRAINING OFFERED BY INDUSTRY. THE SURVEY WAS DESIGNED TO PROVIDE ANSWERS TO FIVE SPECIFIC QUESTIONS--(1) NUMBER OF MEN PERFORMING EACH TASK SPECIFIED, (2) FREQUENCY OF PERFORMANCE, (3) LEVEL OF TECHNICAL KNOWLEDGE REQUIRED TO PERFORM EACH TASK, (4) CONDITION UNDER WHICH EACH TASK IS PERFORMED, AND (5) DEPTH OF TRAINING CONDUCTED BY INDUSTRY. ADJACENT TO EACH OF 52 TABLES WHICH PRESENT THE SURVEY FINDINGS BY SPECIFIED TASKS IS (1) AN OVERVIEW OF WORK-TASK PERFORMED, (2) THE PRINCIPAL FINDINGS, AND (3) THE RECOMMENDATIONS OF THE NATIONAL ADVISORY COMMITTEE. REDIRECTION, APPLICATION, AND PROJECTIONS ARE PRESENTED IN THE REPORT. (JC)

A National Study of the

AVIATION MECHANICS OCCUPATION

1966

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Preface

The project concerning the aviation mechanics occupation was conducted by the Division of Vocational Education as a part of the work of its Center for Research and Service.

The curriculum innovations and data presented in this study offer important contributions to assist vocational educators in the field of aviation mechanics training. The ability to provide the aviation technical schools, on a national level, with current data from all regions and segments of the industry is of immediate and continuing importance. The techniques employed in this study to develop the aviation mechanics core curriculum can be applied in other occupational areas. The industry, the school, the teacher, and the student can in concert advance their educational objectives and needs through research of this type.

Funds to support the research were provided by the United States Office of Education under the provisions of Section 4(c) of the Vocational Education Act of 1963, and by the California State Department of Education, Bureau of Industrial Education. The staffs of the Division of Vocational Education, University of California, Los Angeles, and the Bureau of Industrial Education, California State Department of Education, planned, conducted, and coordinated the study.

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Introduction

A universal concern for the safety of aircraft passengers and flight crews has long been an integral element of the aviation industry. This concern has been revealed in the efforts made by the men and women employed in the industry to uphold and achieve the highest standards of craftsmanship. The creation of state and federal agencies to administer safety regulations has been a further exemplification of a sustained interest in maintaining safety of flight.

Foremost among those who form the work force of the aviation industry are the aviation mechanics, who are characterized by their dedication to air safety and pride of workmanship. Involvement in safety of flight is a part of the working life of each mechanic throughout his employment in aviation. This theme is stated repeatedly in the instruction he receives. Pride of workmanship is a characteristic that develops in the student mechanic from the time he first enters aviation mechanics school. As his skill and knowledge increase, confidence in his ability to perform well also increases, leading to a feeling of pride in his accomplishments and causing him to seek further improvement of his skill and knowledge.

There is in fact no point in his career at which an aviation mechanic can rest in the knowledge that he is fully prepared for the remaining years he may work in aviation. The changing technology of aviation is reflected by new equipment, new aircraft, and constantly recurring changes in aviation engineering. Each change demands that the mechanic have immediate command of the skill and knowledge needed to perform the necessary tasks.

Thus there is need not only for thorough, up-to-date initial training but for continuing in-service training. This study provides a platform from which a system to provide such training can be established. The system includes a means of maintaining curriculum currency in the aviation mechanics schools in accordance with the technological requirements of the aviation industry. It also establishes a method that can guarantee maintenance of the emphasis of instruction at predetermined levels.

The research team greatly appreciates the assistance it received from the many participants in the aviation industry without whose help the survey questionnaire could not have been completed. The advice and guidance from the National Advisory Committee has also been singularly valuable to this research effort. The field analysts who collected the data are to be commended for their diligent efforts toward the successful completion of their work.

Our personal appreciation is hereby extended to Mrs. Travis Latham, editor, and our research support staff, Mrs. Dorothy Bossarte, Mrs. Elinor Shenkin, and Mrs. Karen Kent.

June, 1966 D. A.

Needs, Review, and Plans

Needs

A projection of the occupation of the aviation mechanic is a matter of concern to the aviation industry and the aviation mechanic schools. The growth of the industry is greatly dependent upon the skills and knowledge that the mechanic must acquire to meet the demands of an ever-evolving technology. Changes are occurring that are increasing the intricacy and complexity of aircraft repair, thereby directly affecting the training requirements for the mechanic. The necessity for updating the mechanic's training curriculum and maintaining his technical currency becomes increasingly evident.

THE MECHANIC

The aviation mechanics occupation requires skills and knowledge comparable with those of other highly skilled occupations. Many of the aircraft the mechanic encounters have the most sophisticated operating systems that have yet been developed, and the mechanic must remain current with the "state of the art." To service and repair aircraft, he uses precision tools and instruments in his daily work. Frequently working under time limitations, the mechanic must produce workmanship of the highest quality. The Mechanic's Creed states:[1]

> "Upon my honor I swear that I shall hold in sacred trust the rights and privileges conferred upon me as a certified mechanic. Knowing full well that the safety and lives of others are dependent upon my skill and judgment, I shall never knowingly subject others to risks which I would not be willing to assume for myself, or for those dear to me."

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[1] Flight Safety Foundation, Inc., Aviation Mechanics Bulletin (New York: Flight Safety Foundation, Inc., 1953), p. 16.

The creed depicts the conscientious observance of air safety that is demonstrated by the thousands of aviation mechanics in the nation today.

William L. Lewis of the Cornell Guggenheim Aviation Safety Center describes the qualities needed of those employed in the aviation industry as...imagination, dependability, ingenuity, and...a burning desire to do the best possible job under any set of circumstances.[2] These words identify the major characteristics of the practicing aviation mechanic. Proud of his capabilities to use tools and his technical ability to analyze each new task he faces, the aviation mechanic has been the keystone of air safety.

The expanding role of commercial and general aviation as accepted, reliable modes of transportation is indicative of heightened national interest in aviation. The aviation mechanic is thus becoming more important to a greater number of people.

The rate at which the aviation mechanics occupation is developing and the lines along which the development is occurring will, to a large extent, be influenced by the increase in the number of aircraft in service. In the Occupational Outlook Handbook we find that:[3]

> The rapid growth anticipated in the amount of general aviation flying will lead to an increase in the nur r of planes. Therefore, an increase is expected in the number of mechanics employed in firms providing services and repair stations providing maintenance for the aircraft.

In the postwar years the airline industry has experienced phenomenal growth. This has been due to many factors, the more important being the

[2] Ibid., p. 14

[3] U.S. Department of Labor, Occupational Outlook Handbook, 1966-67 edition (Washington, D. C.: U.S. Government Printing Office, 1965), p. 634.

increased carrying capability of modern aircraft coupled with the dependability of maintenance and operation of these aircraft. G. E. Keck, president of United Airlines, writes in the June, 1966, issue of the Mainliner magazine:[4]

> About seven years ago the U. S. scheduled air Carriers began introducing jet aircraft...The airlines at that time employed approximately 160,000...The airlines now have 200,000 on their payrolls...Over the next five years airline employment is expected to increase by 50,000.

The increased aviation activity in large general aviation and the airlines is creating a growing demand for skilled mechanics. The input of young mechanics is low, however, as has been recently reported in the Federal Aviation Agency Statistical Handbook of Aviation.[5] In 1965 less than 0.5 percent of the certificates were held by the 16- to 19-year-old mechanics; 2 percent were held by the 20- to 24-year-old mechanics, and 7 percent were held by the 25- to 29-year-old mechanics. All aviation mechanics that were 34 years of age or younger represented only 22 percent of the total number of certificated mechanics. Additionally, it has been predicted that the number of mechanics leaving the occupation annually because of retirement will increase from about 1,200 in 1964 to about 3,300 in 1980.[6] If, as these statistics suggest, a trend should develop whereby fewer mechanics are being trained to replace those leaving the industry, a situation of national concern will exist.

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[4] G. E. Keck, "Technology and Employment," Mainliner, Volume 10, Number 6 (June, 1966).

[5] Federal Aviation Agency, FAA Statistical Handbook of Aviation, (Washington, D.C.: U.S. Government Printing Office, September, 1965), p. 69.

[6] Federal Aviation Agency, Report of the Aviation Human Resources Study Board on Manpower Requirements of the Civil Aviation Industry, (Washington, D.C.: 1964), U.S. Government Printing Office, p. 11.

The Aviation Mechanics Occupation

Aviation mechanic schools have for many years been an integral part of the nationwide vocational education progra ι. Throughout the United States these schools have been engaged in training students for employment as certificated aviation mechanics.

In 1965 there were 69 aviation mechanic training programs approved by the Federal Aviation Agency in operation in the nation.[7] Sixty-six of these programs are operated in either the private or public schools and, in addition, two programs are operated in correctional institutions and a third is specifically concerned with the training of missionaries. The schools are located in five geographic regions of the nation. Fifteen are in the eastern region, 12 are in the southern region, 17 are in the central region, 25 are in the western region (of which 17 are in California), and one is in the Pacific region in Honolulu. In contrast, there are 1,180 certificated pilot flight and ground schools in operation in the United States.[8]

There are four distinct types of programs in which an individual may enroll and receive his Airframe and/or Powerplant license. These are the high school and adult trade programs, the vocational and technical programs, the two-year Associate in Arts Degree program, or the four-year Baccalaureate Degree program. Although the Federal Aviation Agency has provided guidelines for the training of aviation mechanics, there is a

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[7] Statistics concerned with mechanics schools appearing in this section are taken from Aviation Technician Education Council, 1965 Survey, Federal Aviation Agency Approved Mechanic School Programs (Pittsburgh: ATEC, 1964), pp. 1-21.

[8] Federal Aviation Agency, List of Certificated Flight and Ground Schools, Advisory Circular, AC No. 140-2B (Washington, D.C.: U.S. Government Printing Office, January 1, 1966)

great disparity between the instructional programs of the various schools. Wide differences exist among the school programs in entrance requirements, length of courses, numbers of hours of instruction, facilities, etc. The schools have attempted to exceed the Federal Aviation Agency requirements and to adjust their instructional activities in fulfilling the aviation industry needs in their local communities. Representatives of the aviation industry have at times contended that distinct courses for training an airline mechanic and a general aviation mechanic should be offered in the schools. Despite the differences that exist in school programs, the schools have in most cases provided comprehensive training for their students. However, with the rapid technical changes, as well as the changes in emphasis of the skills and knowledge required by aviation mechanics, it is becoming more apparent that a core curriculum must be developed that will guarantee depth of training where needed without over-training in areas that are becoming obsolete.

The programs within the schools have not been static. There has been a steady increase in enrollment and a definite trend toward increasing the hours of course instruction. There has also been an expansion of new instructional space. During the years 1964-65, 75,000 square feet of new instructional area became available.[9]

The need for aviation mechanics indicates that aviation mechanic schools will have to train a greater number of mechanics. While they are training these men, the schools will also have to continually review their programs. These revised programs will have to be designed with

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[9] Op. cit., Aviation Technician Education Council, 1965 Survey, p. 21.

the full realization that the aviation mechanic's education does not cease upon his graduation. The schools will have to conduct many additional classes to assist the mechanic in upgrading his skills during his employment in the aviation industry.

In most cases the schools have employed teachers who have had many years of work experience in the aviation industry and who have attempted to remain current with the ever-changing aviation industry. These instructors will have to develop better ways of teaching mechanics how to work within reasonable time limits, and the instruction should be given without neglecting the learning processes. It is imperative that acceptable "return to flight" standards of workmanship be developed by the students.

The challenge for the training and retraining of aviation mechanics is placed squarely before the schools and industry. Both have proven that they can provide the training unique to their objectives. The need now confronting industry and the schools is for the establishment of a basic curriculum that is sufficiently flexible to allow currency with the aviation industry and to provide increased teaching effectiveness.

Review

After 1938, when the Civil Aeronautics Act was passed and the Civil Aeronautics Administration formed, training guidelines were developed by the Civil Aeronautics Administration to identify the tasks an aviation mechanic is customarily expected to perform. Included in these guidelines were specified standards of training and lists of equipment deemed appropriate to accomplish the training objectives. Today, as in the past, the Federal Aviation Agency, with the cooperation of the aviation industry and the aviation schools, is effecting changes in these guidelines whenever the need to make such changes is properly supported.

However, no coordinated program to develop, disseminate, or implement a basic aviation mechanics curriculum has been initiated to meet the changing demands and needs of the aviation industry on a national scale. There has been in fact no nationwide investigation into the mechanic's training needs, beyond the local interpretation and adaptation of the broad Federal Aviation Agency guidelines.

Few studies of any magnitude have been made of the training for the occupation of the aviation mechanic. One study that was prepared is the Report of the Aviation Human Resources Study Board on Manpower Requirements of the Civil Aviation Industry published in 1964 by the Federal Aviation Agency.[10] This study focused particular attention on the manpower and training status of the aviation mechanic.

> Aviation mechanics' work opportunities have been overlooked during the past decade as the aerospace industry and other users of skilled aviation mechanics concentrated on the space drive and drew upon the existing World War II reserve of trained men. As a result, the attention of many educators and of career counselors was diverted so that the output of men trained in the mechanical arts has steadily declined. Since the airlines and the remainder of the civil aviation industry were drawing their high skill and certificated mechanics personnel from the military trained reservoir, the need for training schools and long-range planning was understandably delayed or ignored.

This report continues:

> The mechanic trained personnel released annually from the military services cannot be viewed as a

[10]Federal Aviation Agency, Report of the Aviation Human Resources Study Board on Manpower Requirements of the Civil Aviation Industry (Washington, D.C.: U.S. Government Printing Office, 1964), p. 68.

> readymade resource of aviation mechanics for civil aviation employers. This group has received varying degrees of training in a specialty or semi-skilled category. Substantial retraining or even total new skill training is required before they can qualify for certification by the Federal Aviation Agency.

In 1965, a comprehensive study of the occupation of the aviation mechanic in California was published cooperatively by the Bureau of Industrial Education, California State Department of Education and the Division of Vocational Education, University of California, Los Angeles.[11] The University of California, Los Angeles, research group included David Allen, Richard Lano, and Norman Witt. From this study, a "common core curriculum" for the aviation mechanic in California was suggested. The technical knowledge and manipulative skill levels were identified and from these followed the appropriate teaching levels and methods that assisted in measuring the degree of proficiency attained.

The present nationwide study of the occupation of the aviation mechanic, incorporating the same data-gathering instrument and the same design criteria, was developed from the California study. The data gathered in the California study have been incorporated in the national study to provide expanded survey coverage.

Plans

By the time the California portion of the Study of the Aviation Mechanics Occupation had been concluded, it had become apparent that expansion of the survey to other regions of the continental United States

[11] David Allen, Richard Lano, and Norman Witt, A Study of the Aviation Mechanics Occupation (California State Department of Education and the University of California, Los Angeles, 1966).

would provide vital additional data to identify the tasks and training needs of the mechanic. A national study of the occupation therefore would assist in the identification of core relationships for curriculum development. The study is so designed that it would not restrict the flexibility needed for specialized tasks in local communities. The overall objective of this study is to assist the schools in more nearly satisfying both the training requirements of the Federal Aviation Agency and the employment needs of the industry.

The national survey was undertaken to provide data for the accomplishment of three objectives:

1) To investigate the technical knowledge and manipulative skills of aviation mechanics as required by the aviation industry.
2) To identify a core curriculum for the training of aviation mechanics.
3) To identify the scope of training offered by industry.

STRUCTURE OF THE STUDY

The nationwide research study to explore the occupation of the aviation mechanic was designed to survey airlines and both large and small general aviation companies throughout the continental United States. Small general aviation, for the purposes of this study, is defined as companies that employ five or fewer aviation mechanics. Only aviation companies employing Federal Aviation Agency certificated airframe and/or powerplant mechanics were included in the study. Aviation industrial concentrations are generally situated in large urban areas; however, it was essential to include less populated areas in the study in order to obtain data that might be unique to each particular segment and locale of the industry. Following an aviation density study of the United States, 26 states and the District of Columbia were selected for representation in the study.

ASSUMPTIONS FOR THE STUDY

The study is based on two assumptions: (1) that all manipulative skills require some degree of technical knowledge but not all technical knowledge requires manipulative skill, and (2) that all training in aviation mechanic schools will develop the mechanic's manipulative skills so that he will be able to perform work of return to flight quality.

SURVEY INSTRUMENT

The first questionnaire developed for the study in California was a complex instrument. The instrument was redesigned and validated through a "dry run" in industry for the survey in California.[12] This survey instrument was reviewed by the National Advisory Committee and without change was used in the national study.

The questionnaire was designed so that the collected data could be introduced directly into the aviation mechanics school curriculum. The subtopics studied, each of which represented a task performed by an aviation mechanic, were written in behavioral terms.[13] A code system indicating the aviation mechanic's activities, which was used by those being interviewed, was designed so that varying levels of educational attainment required to perform the various tasks could be identified.

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[12] Allen, Lano, and Witt, A Study of the Aviation Mechanics Occupation, p. 7.

[13] The word "subtopic", which denotes a behavioral task, is used throughout this report to refer to any of the 507 subtopics used in the study.

This identification could then be used to develop teaching levels and to test to determine if the teaching level had been attained.

The nationwide survey was designed to provide answers to five specific questions:[14] (1) the number of men performing each task, identified in the questionnaire as "Men"; (2) the frequency at which these men performed the task, identified as "Freq"; (3) the level of technical knowledge required to do each task, identified as "T/K"; (4) the conditions under which the return to flight manipulative skills had to be performed, identified as "M/S"; and (5) the depth of training conducted by industry, identified as "IND."

The identification of levels of technical knowledge was based on the classification of educational objectives developed by Benjamin S. Bloom and his colleagues. Five levels of technical knowledge were assigned to fit the aviation mechanics occupation. These levels were: (1) knowledge (the ability to recall facts and principles, to locate information, and to follow directions); (2) comprehension (the ability to restate knowledge or to interpret information and drawings needed in performing a job); (3) application (the ability to apply principles or transfer learning to new situations); (4) analysis (the ability to reduce problems to their parts and detect relationships between these parts, such as breaking down a malfunction into its fundamental parts in order to troubleshoot); and (5) synthesis (the ability to assemble the knowledge of principles and procedures needed to complete repairs and to construct new or substitute parts). Manipulative skill, which was under the assumption that established the level of workmanship, was

[14] Allen, Lano, and Witt, op. cit., pp. 8-10

studied in relation to the conditions under which a mechanic necessarily performs his duties, such as working under pressure of time and planning his job before performing the job.

FINAL FORM OF QUESTIONNAIRE

A sample of the questionnaire's layout follows.

Woodwork	Men	Freq	T/K	M/S	IND
1. Building a rib	___	___	___	___	___
2. Building a wing section	___	___	___	___	___
3. Making a spar splice	___	___	___	___	___
4. Other tasks	___	___	___	___	___

The answer code system and method of responding to each item in the questionnaire can best be explained by the following samples concerning the fueling of a light aircraft.

Column 1 (Men)

The number of men engaged in performing a given task.
Example: If two men in your charge are responsible for fueling Piper Cubs, you should enter the figure "2" in Column 1 as shown. (Leave the remaining four column spaces blank.)

	Men	Freq	T/K	M/S	IND
1. Fuel Piper Cub	2	___	___	___	___

Column 2 (Freq)

The frequency of use as applied to your specific situation.
The code system:

1. Used annually
2. Used semi-annually
3. Used monthly
4. Used weekly
5. Used daily

Example: If the two men in the previous example fuel Piper Cubs every day, you should enter the figure "5" in Column 2 as shown.

	Men	Freq	T/K	M/S	IND
1. Fuel Piper Cub	2	5	___	___	___

Column 3 (T/K)

A description of the kind of technical knowledge required of your men to perform a particular task.

The code system:

1. Knowledge — ability to locate information and to follow directions
2. Comprehension — ability to interpret information and drawings needed in performing a job
3. Application — ability to apply principles and to transfer learning to new situations
4. Analysis — ability to break a malfunction into its fundamental parts in order to troubleshoot
5. Synthesis — ability to put together knowledge of principles and procedures to complete repairs and to construct new or substitute parts

Example: If the same two men mentioned in the preceding examples must know how to find and follow the directions for fueling a Piper Cub, you should enter the figure "1" in Column 3 as shown.

	Men	Freq	T/K	M/S	IND
1. Fuel Piper Cub	2	5	1		

Column 4 (M/S)

The conditions under which the manipulative task is performed. The code system:

1. Not needed
2. Reasonable time limit, no advanced job planning required
3. Reasonable time limit and requires advanced job planning
4. Time critical but no advanced job planning required
5. Time critical and requires advanced job planning

Examples: If your two men have a reasonable amount of time in which to fuel the Cub and need not plan the job, you should enter the figure "2" in Column 4 as shown.

	Men	Freq	T/K	M/S	IND
1. Fuel Piper Cub	2	5	1	2	

Column 5 (IND)

The degree of training offered in your industry.
The code system:

1. No training offered
2. Familiarization only offered
3. Basic training offered
4. Detailed training offered

Example: If your organization offers detailed training in the fueling of a Cub, you should enter the figure "4" in Column 5 as shown.

	Men	Freq	T/K	M/S	IND
1. Fuel Piper Cub	2	5	1	2	4

Each task was rated as in the above example. The interviewee answered those items with which his work experience directly related. The research analyst was available to the interviewee for consultation to help clarify the material as needed. In addition to completing the questionnaire, each interviewee entered on an information sheet his name, job title, date of interview, name, address, and type of company by which he was employed (airline, line; airline, overhaul; large general aviation; or small general aviation); number of mechanics that he supervised directly; type of work he performed, and the number of years he had worked as a mechanic. Each interviewee completed those portions of the questionnaire that related directly to the work he was doing.

Thus, equipped with a questionnaire to obtain answers to the five key questions: number of men performing each task, frequency at which the task is performed, level of technical knowledge required, conditions under which manipulative skill is performed, and depth of industry training provided, the research staff was ready to begin implementing the survey.

Implementation, Action, and Results

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Implementation

Before the field work of the survey could begin, areas to be surveyed had to be selected. Aviation directories and aviation publications from governmental and commercial sources were searched for the locations of aviation companies that performed airframe, powerplant, propeller, radio, instrument, and accessory work. The information gained from these sources was supplemented by various Federal Aviation Agency district offices throughout the country, which assisted by providing the names of additional companies that employed certificated mechanics. Certain regions of the United States were identified as those in which occurred the heaviest concentrations of airline and general aviation activity. An industry density pattern was then plotted for the entire country and from this six large geographic areas evolved. The states and the survey areas they formed are listed below.

Area 1* - Idaho, Oregon, Utah, Washington

Area 2 - Colorado, Kansas, Oklahoma, Texas, western Missouri

Area 3 - Illinois, Iowa, Minnesota, eastern Missouri

Area 4 - Florida, Georgia, North Carolina, South Carolina

Area 5 - Maryland, Michigan, Ohio, Pennsylvania, Washington, D.C.

Area 6 - Connecticut, Massachusetts, New Jersey, New York

Fig. 1. Research Areas

*California was excluded because it was previously surveyed, and the California data is included in the national survey.

The names of 285 airlines and general aviation companies appeared in the first compilation. An additional 162 companies were added in accordance with information from the Federal Aviation Agency district offices and flight standards branch offices in each survey area. Upon a closer examination, 61 of the 285 companies first compiled were found unsuited to the purposes of the study. These were removed from the list because they either (1) employed no airframe and powerplant mechanics, (2) had discontinued aviation repair operations, (3) had merged or undergone other business reorganization, or (4) were no longer in business. A total of 386 companies comprised the final list.

SURVEY ANALYSTS

Six survey analysts were employed to conduct the survey. These analysts were professional men, oriented in technical or mechanical areas, selected by the administrators of the research staff on the basis of such factors as maturity and ability to meet people easily. Another essential characteristic of those chosen was an overriding interest in achieving the objectives of the survey. The men who were employed resided in or close to the areas to which they were assigned. A list of the analysts and their regional assignments is contained in Appendix B.

The analysts were instructed in the objectives of the study, the use of the questionnaire, the techniques to be used during the interviews, and the general procedures to use in carrying out the survey. Training sessions were held with each of the analysts at his home city, and these were followed up during the early phases of the survey through frequent contacts to make certain each analyst continued to show a thorough understanding of the survey methodology.

SURVEY ADMINISTRATION

The survey was administered by the University of California, Los Angeles, research staff concurrently in all six areas, and the survey activities of each analyst were supervised by means of two devices: an instruction manual containing administrative guidelines and a supply of interview record forms for use in keeping a log of the analyst's visits to the companies.

The manual contained certain general information, such as instruction for correct completion of the questionnaire, methods to use in preparing for and conducting the interviews, instructions for completing the interview forms, and a list of coding designations for Federal Aviation Agency certificated repair stations. Each manual also contained the following information applicable only to the area it governed: copies of letters of introduction to the companies to be contacted, copies of letters to various Federal Aviation Agency flight standards branch chiefs and maintenance inspectors to introduce the survey and the analyst, a directory of Federal Aviation Agency offices and personnel, a list of companies and personnel to contact, an area route and mileage map, and a full set of interview record forms in duplicate.

The analysts were instructed to use these interview record forms to log the dates of contact, persons contacted, number of airframe and powerplant mechanics employed by the companies, running total of mileage, and general comments. As each form was completed, the analyst was to air mail a duplicate to the University of California, Los Angeles, research office. In addition, correspondence concerning the study received at the research office and considered pertinent to the field was forwarded to the analysts.

Overall supervision of the survey was maintained successfully not only as the interview forms were received from the analyst but also as the analysts maintained telephone contact with the research headquarters at specified points along the route. The need for long distance telephone communication was in reality minimized by use of the interview forms.

NATIONAL ADVISORY COMMITTEE

One of the most important phases of the national study was the formation of the National Advisory Committee. The committee consisted of individuals representing private and public aviation mechanic training schools, small and large general aviation companies, airlines, the United States Department of Labor, and the Federal Aviation Agency. This distribution of background was selected to provide a broad spectrum of knowledge that would assist the research team in achieving the objectives of the study. A list of National Advisory Committee members is included in Appendix A.

The first meeting of the National Advisory Committee took place at the Federal Aviation Agency Aeronautical and Space Center, Will Rogers Field, Oklahoma City, Oklahoma, on November 17, 1965, and was attended by the research staff and all members of the committee. During this meeting the committee was briefed on the goals of the study and of the survey completed in California. The committee was asked to review the survey instrument and the analyst's manual. It was at this meeting that the survey instrument was approved.

The committee recommended that a substantiating cross-check be made of all aviation companies identified within the established six areas. It was also recommended that the research survey analysts contact local

Federal Aviation Agency personnel in order to identify additional aviation companies that employ airframe and powerplant mechanics.

The committee established two parameters for the display of data for the national study. These were:

1) The frequency with which mechanics performed each task should be considered as "high" or "low." Tasks performed less frequently than monthly should be considered as "low," to be shown by the letter "L"; those performed monthly or more frequently should be considered as "high," shown by the letter "H."

2) Survey statistics relating to the number of mechanics performing each task should be grouped and displayed in descending order. The subtopics should be arranged under each topic in the order of percent of men performing the task. Thus, those tasks performed by 10 percent or more of the men in all four categories were listed first and the remainder arranged as "5 to 10 percent," "2 to 5 percent," and "Less than 2 percent," corresponding to the number of men performing the task in each of the four categories.

Ways of disseminating information on the survey were explored. All committee members agreed to present information about the survey and the study at conventions they would attend, as well as through correspondence and local press releases. (Committee members representing the airlines later contacted the Air Transport Association and through that organization informed airline companies of the survey.) A press release describing the national study was prepared by the research office and released through the university public relations office for national distribution.

The Aviation Mechanics Occupation

The committee agreed upon a request submitted by Howard Rosen, United States Department of Labor, for a subsample study to be made to obtain information on how recently the mechanics had received in-service training in current industry practices. The subsample was to have a distribution of approximately 500 questionnaires. This subsample study is discussed in detail under "Industry Efforts" in the "Redirection" section of this report.

Action

DATA COLLECTION

The field survey of the six areas of the United States began on December 1, 1965, and was completed during the first week of March, 1966. At each of the 386 companies contacted, qualified personnel reviewed the survey instrument and received instruction from the analyst for its completion. Wherever it was possible, the analyst mailed the completed questionnaire to the research office immediately following the conclusion of the interview. In other cases when the questionnaire was not completed during the interview, and the analyst was satisfied that the person or persons answering the questionnaire understood it sufficiently to work without further direction, he left it at the company for completion. The person interviewed agreed to return the completed survey material by mail to the research office.

Participants were very cooperative and expressed considerable interest in the purposes of the survey. Approximately 55 percent of the instruments were returned within a few days of an interview. To ensure return of the remaining questionnaires by the earliest possible date, a

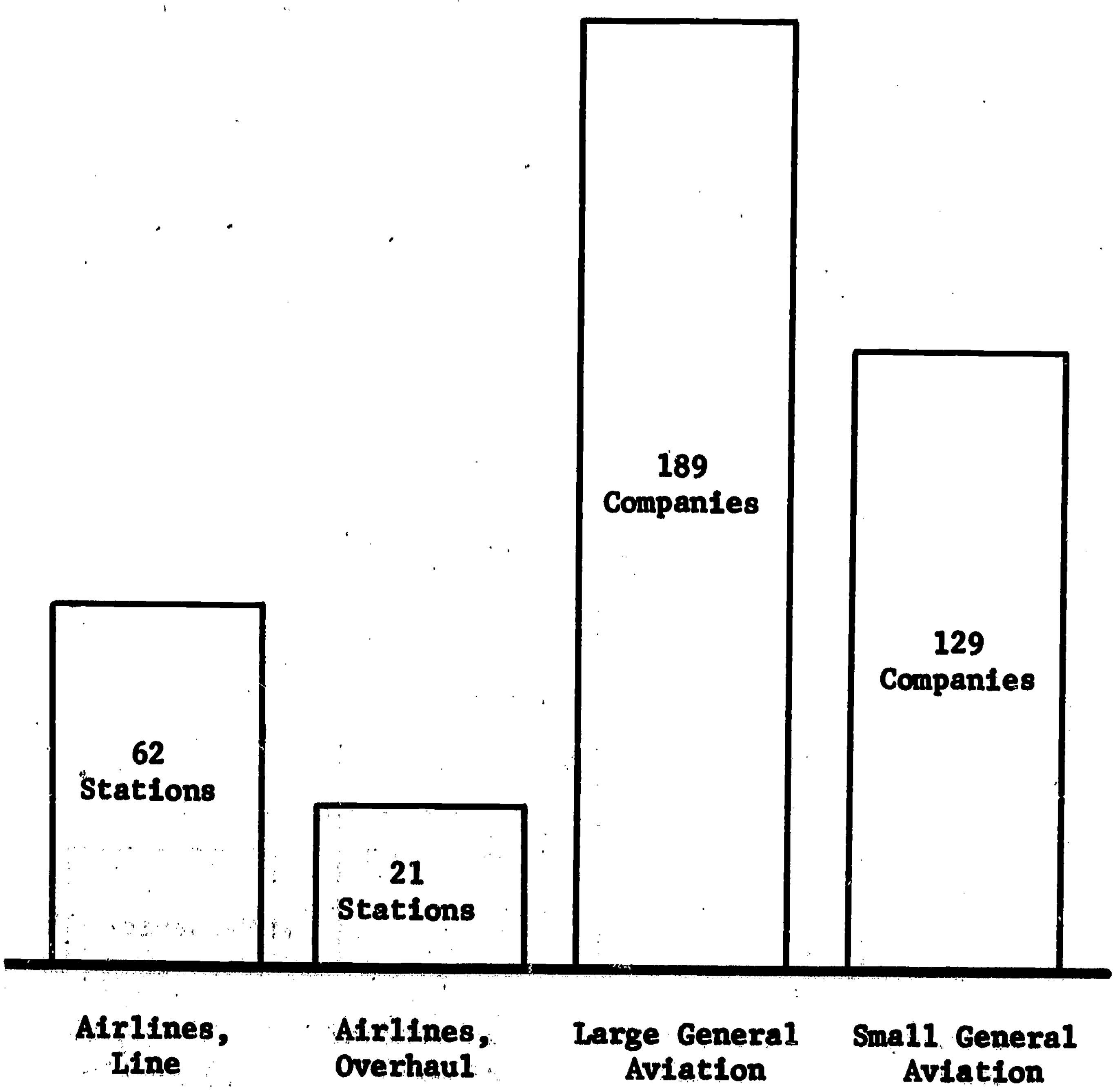

Fig. 2. Distribution of 401 companies and stations responding to the survey.

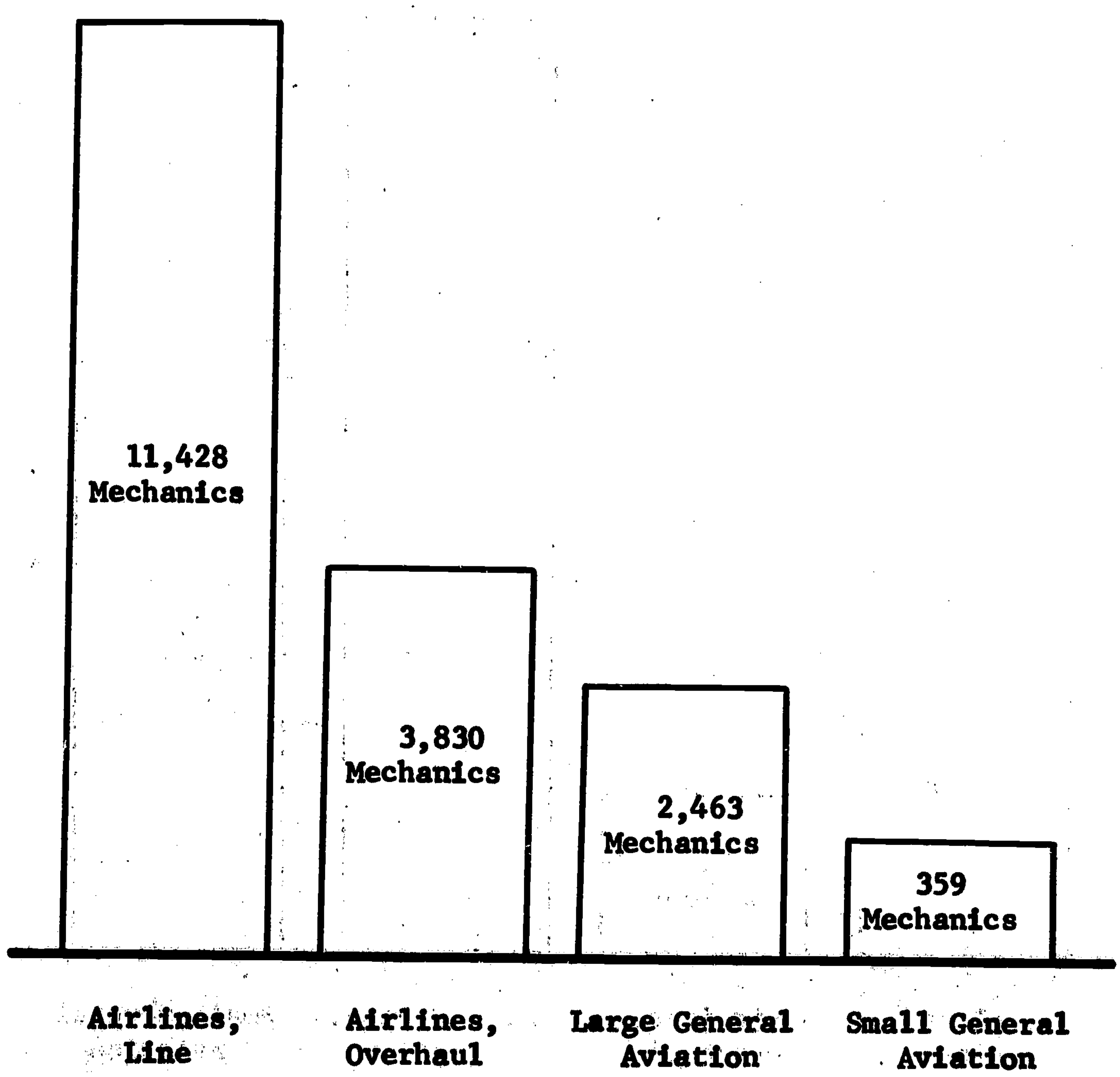

Fig. 3. Distribution of 18,080 certificated airframe and/or powerplant mechanics included in each industrial category reported.

vigorous follow-up program was pursued. First, a letter of reminder was sent from the research staff directly to the individuals within each company responsible for the return of the questionnaire. Then, whenever scheduling permitted and visits were deemed appropriate, the analysts revisited the companies to encourage their response. Finally, a telephone call was made to the responsible company personnel by either the research staff or by the analyst in the area to advise them that the questionnaire must be received at the research office by March 20, 1966, if it was to be prepared for computer tabulation on March 29 as scheduled. As a result of these procedures, 25 percent more companies responded with completed questionnaires.

The national response in numbers of companies and stations is presented in Fig. 2, which includes the companies that responded in the California survey. A total of 485 companies were contacted in both surveys and 401 of these companies responded, representing an 82 percent response. A list of all responding companies is shown in Appendix C.

As the questionnaires were received, the research staff reviewed each completed instrument for possible evidence of misunderstanding or misinterpretation of instructions. If some doubt existed in regard to any item, the individual who completed the questionnaire was contacted by telephone or revisited by the analyst and the item in question was clarified. Problems of this nature were found to have occurred in relatively few cases.

Each questionnaire was then assigned a code number that identified the industrial category to which it belonged and the geographic area from which it originated. The data collected was separated into four major industrial categories: airline line stations, airline overhaul stations, large general aviation companies, and small general aviation companies.

Data collected for each of the subtopics were key punched on IBM cards. By means of computer programming, the information was stored on tape and then processed through an IBM 7094 computer. The final program consisted of a computer program developed by Edwin W. Banhagel of Hughes Aircraft Company.[15] The resultant information was printed out for all four categories, which were arranged and programmed so that the final computer print-out produced the data shown in Tables 1 through 52 of this report.

CURRICULUM DEVELOPMENT PARAMETERS

The tabulated data shown in this report were presented in the same format to the National Advisory Committee at their second meeting, which was held at Purdue University in April, 1966. At this meeting, the members set the parameters that provided criteria for establishing a core curriculum. These parameters were used to identify the subtopics to be included in the core curriculum, and to establish the teaching level to which each subtopic should be taught.

The first parameter identifying the subtopics that should be included in the curriculum was based on the percent of mechanics performing tasks in the aviation industry. From this parameter all tasks performed by more than 2 percent of the mechanics in at least three of

[15] The research staff gratefully acknowledges the services performed by Mr. Banhagel and the fine cooperation received from Hughes Aircraft Company. A detailed description of the program can be found in Allen, Lano, and Witt, op. cit., pp. 159-64.

the industrial categories were to be included in the core curriculum. With this reference point, the committee reviewed all the subtopics. Those that failed to meet this standard were recommended for deletion from the core curriculum; those that did meet this standard were recommended for inclusion in the core curriculum.

The second parameter established a guideline for determining the depth of the training by teaching levels in relation to the consensus level of technical knowledge. Figure 4 illustrates the steps taken to establish a consensus number for the frequency of distribution of technical knowledge for each subtopic.

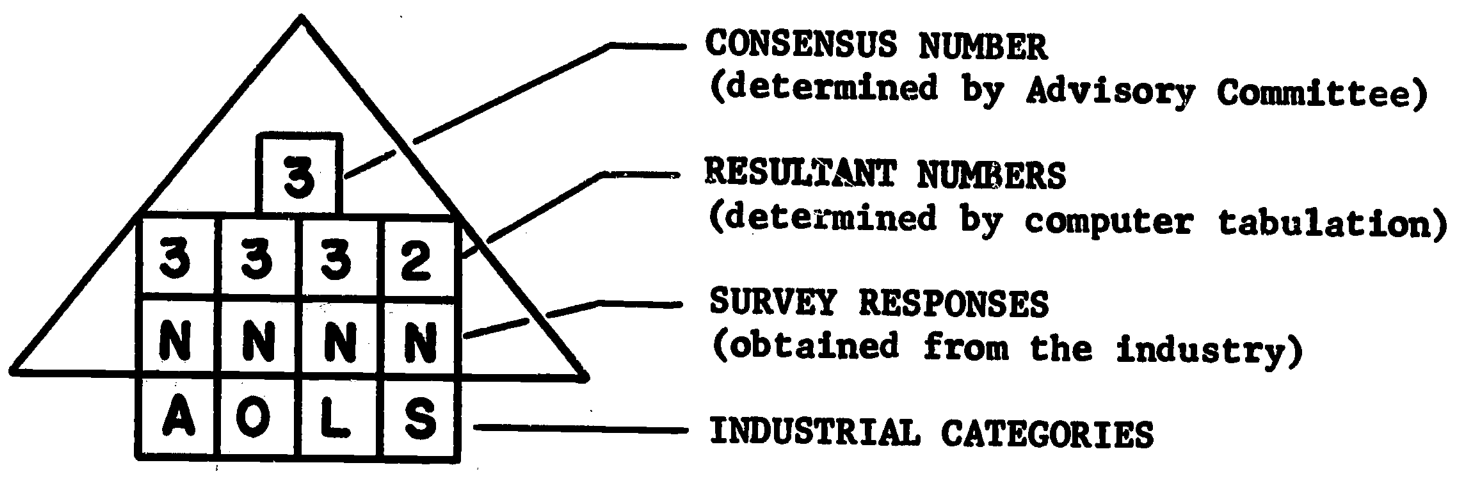

Fig. 4

Beginning at the base of the diagram, the letters A, O, L, and S identify the industrial categories--airline line stations, airline overhaul stations, large general aviation companies, and small general aviation companies--that responded to the survey. The letter N in each square of the next row represents the raw data gained from the survey responses. The numbers 3, 3, 3, and 2 in the third row represent the resultant frequency distribution numbers for the industrial categories as totalled and printed out by the computer. The single number 3 at the top of the diagram represents the consensus number designated by the advisory committee, based on their evaluation of the frequency numbers. The three basic criteria used by the committee to derive the consensus number for this and other frequency number combinations is explained in the following paragraphs.

T/K

	A	O	L	S
Subtopic 1	2	3	3	3
Subtopic 2	3	3	3	4
Subtopic 3	4	4	3	3

Fig. 5. Parameter: frequency of technical knowledge

Figure 5 is a display of typical distributions of these numbers for each subtopic that may have occurred in the industrial categories as accumulated by the computer tabulation of raw survey data. For example, Subtopic 1, Fig. 5, shows a combination of "2333." This combination might have occurred as "3233," "3323," or "3332." The order in which these numbers were distributed was unimportant inasmuch as the consensus number resulting from any of these combinations would be the same.

In the first criterion, a combination of four numbers formed by three similar numbers and one lower number, as in the case of Subtopic 1, was considered equal to the three higher numbers. The number "2333" was thus considered to have the value of "3333." This combination was evaluated as a single number representing the level of technical knowledge for this subtopic. The numerical value of "3333" then became "3," which is the consensus number equivalent to the application level in technical knowledge.

In the second criterion, a combination of four numbers formed by three similar numbers and one higher number, as in the case of Subtopic 2, was considered equal to the three lower numbers. The number "3334" was thus considered to have the value of "3333," with a consensus number of "3." The one higher number appearing in this combination was considered to indicate the feasibility of providing extension training at the fourth technical knowledge level, where geographic location or industrial needs warrant.

In the third criterion, the median number was considered when mixed combinations of numbers occurred. A numerical distribution whose average value was 3.50 or less was considered a "3333," or "3," and a numerical distribution whose average value was 3.51 or more was considered a "4444." This combination then became a "4," the analysis/synthesis level in technical knowledge. In Fig. 5 the distribution "4433" is seen to have occurred for Subtopic 3. This group of numbers was considered to equal 3.50, which was evaluated as "3." If this subtopic had received a number distribution of "5433," for example, the group of numbers would have had an average value of 3.75 and would thus have been considered equal to "4." However, the committee agreed that, in the case of mixed number combinations, the level of instruction could be set by each school in accordance with local industrial needs and local advisory committee recommendations. A distribution of "4433" could then be adjusted to "4" as indicated locally, or remain at "3" as recommended by the National Advisory Committee.

In addition to the two parameters for identifying subtopics to be included in the core curriculum and depth of training, two additional criteria were established to assist in making teaching depth judgments. One dealt with the depth of training given in industry, as well as the type of equipment on which the training was given. The second criteria was based on the conditions under which manipulative skills are being performed by the mechanics in the industry under time pressure. Thus, with guidelines for identifying subtopics and establishing teaching levels, the committee was able to review the entire data and make the recommendations appearing with each of the Tables 1 through 52. The depth of training, the instructional settings, and the testing levels are described fully in the following discussion under "Teaching Levels."

TEACHING LEVELS

The National Advisory Committee was guided by four established levels of instruction to which any subtopic in the core curriculum could be taught. Each teaching level was given equivalent testing levels, "Knowledge," "Comprehension," "Application," and "Analysis/Synthesis," to determine whether the training had been achieved. In addition, four instructional settings for teaching airframe and powerplant subtopics (Condition I) and four instructional settings for teaching subtopics in related subjects, such as mathematics and physics, (Condition II) were established.

The teaching levels for airframe and powerplant instruction are:

<u>Level</u>

1 Knowledge of sources of information and ability to follow directions

2 Ability to interpret information and drawings needed in performing a job

3 Knowledge and understanding of principles and processes and ability to apply them to specific situations

4 Ability to separate a malfunction into its fundamental parts in order to troubleshoot, and ability to put together knowledge of principles and procedures to complete repairs, including construction of new or substitute parts

The description of the instructional setting for airframe and powerplant instruction and testing for each teaching level is as follows:

Instructional Setting (Condition I)

A - Instructional Setting A should be an orientation lesson. A subtopic should be mentioned in a lecture but there should be no manipulative instruction. Testing should be at the knowledge level.

B - Instructional Setting B should be an overview of the subtopic, including both technical and manipulative training. Testing should be at the comprehension level.

C - Instructional Setting C should present detailed instruction so that the student can, with additional review, recall the information readily later when he has been employed. Testing should be at the application level.

D - Instructional Setting D should train in depth, in both technical and manipulative skills, to facilitate transfer of learning with minimum difficulty. The student, when later employed, should be able to start a task with minimal instruction. Testing should be at the analysis/synthesis level.

In related subjects, such as mathematics and physics, four instructional settings were established:

Instructional Setting (Condition II)

E - Instructional Setting E should be an overview. Testing should be at the knowledge level.

F - Instructional Setting F should include basic, workable skills in the fundamentals of the subtopic. Testing should be at the comprehension level.

G - Instructional Setting G should be presented in enough detail so that recall can be accomplished with little additional training.

Instructional Setting (Condition II) - continued

Specific safety information should be strongly emphasized. Testing should be at the application level.

H - Instructional Setting H should train in depth to facilitate direct transfer of learning. It should include the specific information required to ensure safety and should result in a complete mastery of the subject so that a return to flight attitude can be maintained by the mechanic. Testing should be at the analysis/synthesis level. Great stress should be placed on developing a positive attitude toward safety in the mechanic so that he carries this attitude through his productive years.

The relationships among these four major headings are shown below.

TEACHING LEVELS	INSTRUCTIONAL SETTING (Condition I)	INSTRUCTIONAL SETTING (Condition II)	TESTING LEVELS
1	A	E	Knowledge
2	B	F	Comprehension
3	C	G	Application
4	D	H	Analysis/Synthesis

Several times the National Advisory Committee changed the instructional setting but did not change the teaching level. For example, it was occasionally recommended that a subtopic being taught to Teaching Level 2 should provide an overview of the subtopic with technical training included; however, it was recommended that manipulative training be deleted. Testing should continue at the comprehension level.

Results

On the following pages are the tables presenting all of the data collected by the survey. Each table represents a major topic heading and shows the subtopics performed by the aviation mechanic. The subtopics are arranged in descending order from most frequent to least frequent, as determined by the percent of mechanics performing that task.

KEY TO TABLES

Data is presented in five columns with the headings identified as "N," "F," "T," "M," and "I," shown in the example below.

	N	F	T	M	I

The headings represent the following:

N............Percent of mechanics performing the task

F............Frequency with which the task is performed

T............Technical knowledge required to perform the task

M............Manipulative skill required to perform the task

I............Industry training offered

Each of the preceding columns is divided in accordance with the four industrial categories, identified by "A," "O," "L," and "S," shown in example below:

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S

The categories represent the following:

A............Airline line stations

O............Airline overhaul stations

L............Large general aviation companies

S............Small general aviation companies

Data applicable to the "N" column in example below is represented by the following symbols, which indicate the percentage of mechanics performing each task:

+ Tasks performed by 10 percent or more of the mechanics in that industrial category

$ Tasks performed by 5 to 10 percent of the mechanics in that industrial category

- Tasks performed by 2 to 5 percent of the mechanics in that industrial category

No symbol Tasks performed by less than 2 percent of the mechanics in that industrial category

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
	$	-	+	+																

Data applicable to the "F" column, in example below, is represented by the following letters indicating the frequency with which the task is performed:

L The job is performed semi-annually or less often (low frequency)

H The job is performed daily, weekly, or monthly (high frequency)

No letter The task is not performed

	N A O L S	F A O L S	T A O L S	M A O L S	I A O L S
	$ - + +	H H L H			

Data applicable to the "T" column in example below is represented by the following numbers indicating the technical knowledge required to perform a given task:

1 - Knowledge

2 - Comprehension

3 - Application

4 - Analysis

5 - Synthesis

	N A O L S	F A O L S	T A O L S	M A O L S	I A O L S
	$ - + +	H H L H	3 3 3 3		

Data applicable to the "M" column in example below is represented by the following numbers denoting the manipulative skill required by the task:

1 - Not needed

2 - Reasonable time limit, no job planning required

3 - Reasonable time limit, job planning required

4 - Time critical, no job planning required

5 - Time critical, job planning required

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
	$	-	+	+	H	H	L	H	3	3	3	3	3	4	3	3				

Data applicable to the "I" column in example below is represented by the following numbers denoting the degree of training offered by industry:

1 - No training offered

2 - Orientation or familiarization training offered

3 - Basic or general information training offered

4 - Training in depth offered

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
	$	-	+	+	H	H	L	H	3	3	3	3	3	4	3	3	3	4	2	3

Beginning with Table 44, the "M" column is replaced by the "A/S" column, as in example below. The applicable "A/S" data is represented by the following numbers denoting whether accuracy and/or speed is required in performing each task:

1 - The task must be performed with accuracy

2 - The task has to be done with accuracy and speed

(Note: Table 52, "Ethics and Legal Responsibilities," does not have an "M" or "A/S" column, because neither of these factors is applicable to the topic.)

	N				F				T				A/S				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
	$	-	+	+	H	H	L	H	3	3	3	3	1	2	1	1	3	3	2	3

Note: When a blank appears in all 5 columns in any one industrial category, it means the task is not performed by that industrial category.

Adjacent to each table is (1) overview of work performed by an aviation mechanic (2) the principal findings of the survey (3) the recommendations of the National Advisory Committee. All subtopics studied are listed so that schools can evaluate the results and the recommendations of the National Advisory Committee as a basis for possible inclusion in their curriculum of some of the subtopics not recommended by the National Advisory Committee.

TABLE 1. WOODWORK

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
MAKE RIB REPAIR			$	+			L	L			3	3			3	3			3	3
USE GLUES AND CLAMPS			$	+	H		L	L	3		3	3	3		3	3	3		3	3
IDENTIFY WOOD DEFECTS			$	+							3	3			2	3			3	3
BUILD A RIB			-	+			L	L			5	3			3	3			3	3
BUILD WING SECTION			-	+			L	L			3	3			3	3			3	1
MAKE SPAR SPLICE			-	+			L	L			5	3			3	3			3	3
USE NACA AIRFOIL SPECIFICATIONS			-	+			L	L			3	3			3	3			3	1
CONSTRUCT JIGS			-	+		H	L	L		4	5	3		3	3	3		1	3	3
SELECT MATERIALS			-	+	H		L	L	3		3	3	3		3	3	1		3	3
HANDLE AND STORE WOOD			-	+	H		L	L	1		1	3	2		3	3	1		3	3
TEST STRENGTH OF SPLICES			-	+			L	L			1	3			3	3			3	3
MAKE APPROVED SPLICES			-	+	H		L	L	3		3	3	4		3	3	1		3	3

TABLE 1

WOODWORK

OVERVIEW OF WORK PERFORMED

While the trend is undoubtedly toward metal aircraft, many airplanes still exist in which wood was used as the structural material for spars and ribs. Inspection and repair of these wooden structures will continue to be the responsibility of the aviation mechanic, because deterioration is continuous and cracks in glued joints are in many cases difficult to detect. The mechanic must be familiar with and able to recognize defects in wood structures such as dry rot, compression failures, etc.

The manufacture of duplicate replacement parts and the application of protective finishes is performed by the mechanic, and woodworking machines are used during these processes.

PRINCIPAL FINDINGS

N - Very few mechanics employed by the airlines and large general aviation companies do any woodworking. Where such jobs exist in general aviation, they are being done by a small percentage of mechanics, most of whom specialize in this type of work.

F - The frequency with which mechanics employed by general aviation companies perform such work is low.

I - Basic or general information training is provided by the general aviation industry.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

A mechanic should have the ability to inspect wood structures and make correct decisions regarding airworthiness of the structures. Although all subtopics except the identification of wood defects are to be taught at Teaching Level 1, which precludes manipulative training, the committee strongly recommended that the mechanic be familiar with the use of woodworking tools. All subtopics should be included in the core curriculum at Teaching Level 1, except the identification of wood defects, which should be taught at Teaching Level 2.

TABLE 2. FABRIC COVERING

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
INSPECT AND REPAIR STRUCTURE FOR COVER			+	+	L	H	L	H	2	3	3	3	2	3	3	3	2	4	3	3
SELECT MATERIALS			+	+	L		L	H	3		3	3	3		3	3	1		3	3
PERFORM HAND SEWING			+	+	H	H	L	H	3	3	3	3	3	3	3	3	1	4	3	3
COVER WING, STRUCTURE, OR CONTROL SURFACE			+	+	H		L	H	3		3	3	3		3	3	3		3	3
REPAIR FABRIC			+	+	L	H	H	H	3	3	3	3	3	3	3	3	2	4	3	3
PERFORM FABRIC PROTECTION AND TESTING			+	+	L	H	H	H	3	3	3	3	3	3	2	3	1	4	3	3
PERFORM POWER SEWING			$	+	H	H	L	L	2	2	3	3	3	3	3	3	2	1	3	3

TABLE 2

FABRIC COVERING

OVERVIEW OF WORK PERFORMED

In the past, and at present, on slower, lighter aircraft, fabric has been used to cover a portion of the airplane structure. Mechanics select and identify materials, make repairs, and test fabric to determine the airworthiness of the fabric cover. Fabric covering of a wing, structure, or control surface requires the ability to cut fabric to proper size and to sew and to properly attach the fabric to the aircraft.

PRINCIPAL FINDINGS

N - Less than 2 percent of the airline mechanics work with fabric covering. They find their work generally limited to the inspection, testing, and repair of fabric covered control surfaces.

F - Major aircraft-covering jobs and power sewing are performed at a low frequency by mechanics employed by large general aviation companies.

I - The airline overhaul mechanic is given in-depth training when his employer assigns him the tasks identified in this table.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

The subtopic "Perform power sewing" should be deleted from the curriculum. The committee observed that power sewing is generally done by mechanics in a specialized shop and should not be a part of a mechanic's basic skill. The subtopic "Inspect and repair structure for cover" was also deleted from this area, "Fabric covering," inasmuch as it is more applicable to "Woodwork" and "Sheet Metal." All other subtopics should be included in the aviation mechanics core curriculum.

TABLE 3. PAINTING AND FINISHING

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
PREPARE SURFACE AND PRIME	$	-	+	+	H	H	H	H	2	3	3	3	3	3	3	3	2	4	3	3
BRUSH PAINTING	$	-	+	+	H	H	H	H	2	3	3	3	3	3	2	3	2	3	3	3
SPRAY PAINTING	$	-	+	+	H	H	H	H	3	3	3	3	3	3	3	3	2	4	3	3
LAYOUT LETTERS AND MASK	$	-	+	+	H	H	H	H	3	3	3	3	3	3	3	3	2	4	3	3
LAYOUT TRIM DESIGN	$	-	+	+	H	H	H	H	3	3	3	3	3	3	3	3	3	4	3	3
INSPECT AND IDENTIFY DEFECTS	$	-	+	+	H	H	H	H	3	3	3	3	3	3	3	2	2	4	3	3
TOUCH-UP PAINTING	$	-	+	+	H	H	H	H	3	3	3	3	3	3	2	3	2	1	3	3
APPLY DOPE			+	+	H	H	H	H	3	3	3	3	3	3	3	3	3	4	3	3

TABLE 3

PAINTING AND FINISHING

OVERVIEW OF WORK PERFORMED

Metal- or wood-covered aircraft are usually painted to protect their surfaces and to provide a desirable appearance. Fabric covering requires the mechanic to brush or spray multiple coats of clear or pigmented dope on the surfaces to preserve and tighten the fabric. Wood structures are varnished, while aluminum and steel are protected and preserved by painting with zinc chromate or other similar finishes. The application of aircraft identification numbers and letters and trim striping requires the mechanic to be familiar with available materials and methods employed for their application.

PRINCIPAL FINDINGS

F - Mechanics in all occupational categories perform painting and finishing at a high frequency. Few airline mechanics apply dope, yet the frequency for painting and finishing is high.

I - Airline overhaul stations offer extensive training in the majority of the painting and finishing subtopics.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum. The committee observed that the time and effort required to lay out trim design and letters, mask, and do touch-up painting can only be justified at the knowledge level of teaching. The committee further recommended that all training programs remain alert to the introduction of new materials and processes in this subject area.

TABLE 4. SHEET METAL

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
INSTALL CONVENTIONAL RIVETS	+	+	+	+	H	H	H	H	3	3	3	3	3	3	3	3	3	3	3	3
DIMPLE METAL	+	+	+	+	H	H	H	H	3	3	3	3	5	3	3	3	3	3	3	3
INSTALL SPECIAL RIVETS	+	+	+	+	H	H	H	H	3	3	3	3	5	3	3	3	4	3	3	3
INSTALL SPECIAL FASTENERS	+	+	+	+	H	H	H	H	3	3	3	3	3	3	3	3	3	3	3	3
MAKE PATCHES	+	+	+	+	H	H	H	H	3	3	3	3	3	3	3	3	3	3	3	3
MAINTAIN AERODYNAMIC SMOOTHNESS	+	+	+	+	H	H	H	H	3	3	3	3	3	3	3	3	3	3	3	3
FABRICATE FROM TEMPLATE	$	+	+	+	L	H	H	L	3	2	3	3	5	3	3	3	4	3	3	1
HAND FORMING	$	+	+	+	H	H	H	H	3	2	3	3	3	3	3	3	3	3	3	3
PROTECT METAL FROM DAMAGE	$	+	+	+	H	H	H	H	3	3	3	3	3	3	2	3	3	3	2	3
USE BEND ALLOWANCE	$	+	+	+	H	H	H	H	3	3	3	3	3	3	3	3	3	4	3	3
IDENTIFY AND CONTROL CORROSION	$	+	+	+	H	H	H	H	3	1	3	3	3	3	3	3	3	3	3	3
REPAIR STRUCTURE	-	+	+	+	H	H	H	H	3	3	5	3	5	3	3	3	4	3	3	3
USE ADHESIVE METAL BONDING	-	+	+	+	H	H	H	H	3	3	3	3	4	3	3	3	4	4	3	3
DEVELOP TEMPLATE FROM BLUEPRINT	$	$	+	+	L	H	H	L	3	3	3	3	5	3	3	3	4	4	3	1
INSPECT AND REPAIR PLASTICS AND FIBERGLASS	-	-	+	+	H	H	H	H	3	3	3	3	3	3	3	3	4	4	3	3
SHAPE METAL I.E. HOT WORKING, COLD WORKING, CASTING, CHEMICAL MILLING, ETC.		-	+	+	H	H	H	L	3	2	3	3	3	3	3	3	4	3	3	1
REPAIR HONEYCOMB AND LAMINATED STRUCTURE	-	-	$	+	H	H	L	L	3	3	3	3	5	3	3	3	4	4	3	3

TABLE 4

SHEET METAL

OVERVIEW OF WORK PERFORMED

Structural members of the modern airplane are made of aluminum alloys, steel, and other non-ferrous metals and honeycomb structures. The outer covering, or "skin," of the airplane is generally made of aluminum alloy or other non-ferrous sheet metals. Aviation mechanics manufacture, assemble, repair, and fasten parts together by riveting, welding, and bonding. Special fasteners and fittings are installed as a part of this process. Mechanics inspect the structure for damage or normal wear and control corrosion by application of primers, chemical bonds, and plating.

PRINCIPAL FINDINGS

N - All mechanics perform the tasks identified in this table. The shaping of metal by hot or cold working, casting, chemical milling, etc., is performed by less than 2 percent of the mechanics employed at airline line stations.

F - Airline line mechanics and mechanics employed by small general aviation companies infrequently develop templates or fabricate parts from templates. The repair of honeycomb and laminated structure is performed infrequently by general aviation companies.

M - Airline line station mechanics do sheet metal work under critical time limitations that require job planning.

I - The airline industry provides training in depth in several of the tasks.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum. The committee recommended that manipulative skill should not be taught for the subtopics "Protect metal from damage" and "Identify and control corrosion." The theory and techniques of shaping metal, i. e. hot working, cold working, casting, chemical milling, etc., should be presented in sufficient detail so the mechanic can properly conduct an inspection.

TABLE 5. WELDING

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
SOLDER	$	$	+	+	H	H	H	H	3	3	3	3	2	3	3	3	4	3	3	3
IDENTIFY TYPES OF WELDED JOINTS		-	+	+	H	H	H	H	1	2	3	3	2	3	3	3	1	3	3	3
WELD STAINLESS STEEL		-	+	+	H	H	H	H	3	3	3	3	3	3	3	3	4	3	1	1
ARC WELDING		-	+	+	H	H	H	H	3	3	3	3	3	3	3	3	4	3	1	1
SOLDER STAINLESS STEEL		-	+	+	H	H	H	H	3	3	3	3	3	3	3	3	3	3	3	1
FABRICATE TUBULAR STRUCTURES		-	+	+	H	H	H	L	3	3	3	3	3	3	3	3	3	3	1	1
CONTROL ALIGNMENT WHILE WELDING		-	+	+	H	H	H	H	3	3	3	3	3	3	3	3	3	3	2	1
INSPECT AND TEST WELDS		-	+	+	H	H	H	H	4	3	5	3	5	3	1	3	4	3	3	3
WELD STEEL (GAS)			+	+	H	H	H	H	3	3	3	3	3	3	3	3	4	3	3	1
WELD ALUMINUM			+	+	H	H	H	H	3	3	3	3	3	3	3	3	4	3	1	1
BRAZE			+	+	H	H	H	H	3	3	3	3	3	3	3	3	3	3	3	3
REPAIR TANK		-	$	+	H	H	H	L	3	3	3	3	3	3	3	3	1	3	3	1
WELD MAGNESIUM				-	H	H	L	L	3	3	3	3	3	3	3	5	4	3	3	1
WELD TITANIUM				-	H	H	H	H	3	3	3	3	3	3	3	5	4	3	1	1

TABLE 5

WELDING

OVERVIEW OF WORK PERFORMED

Recent developments and refinements in inert gas welding have brought significant changes in the methods of joining metals in aircraft. Conventional gas and arc welding are done by the mechanic in repairing tubular aircraft components, minor subassemblies and shop equipment. Some mechanics who have special training, or certification, weld stainless steel and magnesium, as well as titanium and other exotic metals. It is most important that mechanics be able to identify the quality of the weld.

PRINCIPAL FINDINGS

N - A smaller percent of mechanics employed by the airlines do welding, compared with mechanics employed in general aviation.

F - Although only a few selected airline mechanics do welding, they perform this task at a high frequency. The frequency with which mechanics employed by small general aviation companies fabricate tubular structures, repair tanks, and weld magnesium is low.

I - Less than 2 percent of the airline line mechanics do welding, but they indicate that they receive in-depth training in the majority of the tasks identified.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum. For purposes of inspection, a mechanic must be able to identify the various types of welded joints and be capable of judging the quality of the weld. Welding in the core curriculum should be at the application level; however, those students specializing in aircraft welding for certification must enroll in special classes.

TABLE 6. ASSEMBLY AND RIGGING

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
USE MANUFACTURER'S AND FAA SPECIFICATIONS	$	$	+	+	H	H	H	H	2	3	3	3	4	1	3	3	3	3	3	3
RIG MOVEABLE SURFACES	$	-	+	+	H	H	H	H	3	3	5	3	3	3	5	3	4	4	3	3
RIG FIXED SURFACES		-	+	+	H	H	H	H	3	3	3	3	3	3	3	3	4	4	3	3
RIG AIRCRAFT		-	+	+	H	H	H	L	3	3	3	3	3	3	3	3	4	4	3	3
USE TRANSIT			+	+	L	H	L	L	3	3	3	3	3	3	3	3	1	3	1	1
TRAM AND ALIGN STRUCTURE			+	+	L	H	H	L	3	3	3	3	3	3	3	3	3	3	3	3
BALANCE CONTROL SURFACES			+	+	L	H	L	L	3	3	3	3	3	3	3	3	3	3	3	3

TABLE 6

ASSEMBLY AND RIGGING

OVERVIEW OF WORK PERFORMED

Every airplane has its particular method of assembly. The number of externally braced aircraft is decreasing. Designs that incorporate external braces and wires permit many adjustments; modern internally braced airplanes permit few adjustments by mechanics in the field. Aircraft rigging implies the alignment of components to achieve acceptable flight characteristics. Furthermore, improper assembly and rigging may result in certain members being subjected to loads greater than those for which they were designed. Mechanics, therefore, closely adhere to the manufacturer's and FAA specifications when installing, aligning, or balancing both fixed and movable control surfaces. Aircraft with hydraulic or electric boost-assisted controls demand a high level of mechanical craftsmanship.

PRINCIPAL FINDINGS

N - A greater percentage of the mechanics employed by general aviation companies perform assembly and rigging operations than do the mechanics employed by the airlines.

F - Mechanics in all of the industrial categories make frequent use of manufacturer's and FAA specifications.

T - Mechanics employed by large general aviation companies must frequently put together knowledge of principles and procedures when rigging movable surfaces.

M - Mechanics employed by large general aviation often work under critical time conditions requiring job planning when rigging movable surfaces.

I - The airlines give training in depth for the rigging of aircraft, movable surfaces, and fixed surfaces.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum. The committee suggested that the correct installation and assembly of bolts and similar items of special hardware is of sufficient importance to justify addition of a separate subtopic titled "Assembly of aircraft" to the curriculum. In the core curriculum on page 179 a new subtopic "Assembly of Aircraft" has been included to be taught at Teaching Level 3.

TABLE 7. LANDING GEAR

	N A O L S	F A O L S	T A O L S	M A O L S	I A O L S
SERVICE AND REPAIR					
LANDING GEAR	+ - + +	H H H H	3 3 3 3	3 3 3 3	3 4 3 3
INSPECT AND REPLACE TIRES AND WHEELS	+ - + +	H H H H	3 3 3 3	3 3 2 3	3 4 3 3
SERVICE AND REPAIR					
LEVELING DEVICES	+ - + +	H H H H	3 3 3 3	4 3 3 3	3 4 3 3
SHOCK STRUTS	+ - + +	H H H H	3 3 3 3	3 3 3 3	3 3 3 3
NOSE WHEEL STEERING	+ - + +	H H H H	3 4 3 3	3 5 3 3	3 4 3 3
BRAKES	+ - + +	H H H H	3 3 3 3	3 3 3 3	3 4 3 3
JACK AIRCRAFT AND TEST GEAR	$ - + +	H H L H	3 4 4 3	3 5 1 3	3 4 3 3
INSPECT DAMAGE AND WEAR TO LIMITS	$ - + +	H H H H	3 4 3 3	2 3 3 3	3 4 3 3
CHECK ALIGNMENT	- - + +	L H H H	1 4 3 3	3 3 2 3	1 4 3 3
SERVICE AND REPAIR					
ANTI-SKID DEVICES	- - + +	H H H L	4 4 3 3	3 3 3 3	3 4 3 3

TABLE 7

LANDING GEAR

OVERVIEW OF WORK PERFORMED

The landing gear of an airplane consists of main and auxiliary units, either of which may be retractable or fixed. The landing gear may include various combinations of wheels, shock absorbing equipment, brakes, retracting mechanism with controls, actuators, warning devices, fairings, and structural members necessary to attach it to the primary structure. Mechanics operate, service, adjust, inspect, repair, and maintain these many systems.

PRINCIPAL FINDINGS

F - Mechanics in all occupational categories work on landing gear at a high frequency.

T - Airline overhaul mechanics perform several tasks at the analysis level, requiring an ability to break down a malfunction into its fundamental parts--to perform troubleshooting during overhaul.

M - In three of the subtopic tasks, airline mechanics must perform their work under the pressure of time limitations.

I - Airline overhaul stations provide training in depth, while industry training is basic and informational in content.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum. The committee observed that, with the possible exception of powerplants, the landing gear requires the most frequent inspection, maintenance, and service.

TABLE 8. HYDRAULIC AND PNEUMATIC SYSTEMS

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
OPERATE AND SERVICE HYDRAULIC SYSTEM AND COMPONENTS	+	$	+	+	H	H	H	H	3	3	4	3	3	1	4	3	3	3	3	3
OPERATE AND SERVICE PNEUMATIC SYSTEM AND COMPONENTS	+	$	+	+	H	H	H	H	3	4	4	3	3	5	4	3	3	4	1	3
IDENTIFY VARIOUS TYPES OF HYDRAULIC SYSTEMS	+	-	+	+	H	H	H	H	3	3	4	3	3	1	2	3	3	3	3	3
IDENTIFY VARIOUS TYPES OF PNEUMATIC SYSTEMS	+	-	+	+	H	H	L	L	3	3	4	3	3	1	1	3	3	3	4	3
IDENTIFY HYDRAULIC FLUIDS	+	-	+	+	H	H	H	H	3	3	4	3	2	1	5	3	3	3	3	3
INSTALL FITTINGS AND LINES	+	-	+	+	H	H	H	H	3	3	3	3	3	3	3	3	3	3	3	3
INSPECT AND REPAIR HYDRAULIC SYSTEM AND COMPONENTS	$	$	+	+	H	H	H	H	3	3	3	3	5	1	3	3	3	3	3	3
INSPECT AND REPAIR PNEUMATIC SYSTEM AND COMPONENTS	$	$	+	+	H	H	H	H	3	3	4	3	5	5	3	3	3	3	3	3
FABRICATE ALUMINUM LINES	-		+	+	H	H	H	H	3	3	4	3	2	3	3	3	3	3	3	3
FABRICATE STAINLESS LINES	-		+	+	H	H	H	H	3	3	3	3	2	3	3	3	3	3	3	3

TABLE 8

HYDRAULIC AND PNEUMATIC SYSTEMS

OVERVIEW OF WORK PERFORMED

The size, weight, and speed of the modern airplane has made necessary the development of more sophisticated and complex hydraulic and pneumatic systems. The aviation mechanic operates, services, inspects, repairs, and maintains these systems. This responsibility varies from simple identification of hydraulic fluids and seals to the ability to analyze and troubleshoot reported system malfunctions.

PRINCIPAL FINDINGS

F - Mechanics in all industrial categories perform work at a high rate of frequency on hydraulic systems.

T - Large general aviation companies require their mechanics to work at the analysis level, troubleshooting hydraulic and pneumatic systems.

M - Mechanics employed by the airlines and large general aviation companies must perform several of the tasks under critical time conditions, requiring job planning.

I - Airline overhaul mechanics receive in-depth training in the operation and servicing of pneumatic systems and components.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum. The committee recommended the addition of a subtopic titled "Selection, and installation of 'O' rings and seals" to emphasize a task often performed by the mechanic. He should also be aware of the function of "O" rings and seals. The term "repair" as applied to components in the hydraulic and pneumatic systems was further defined by the committee to describe a "remove and replace" function. In the core curriculum on page 180 under "Hydraulic and Pneumatic Systems," a subtopic titled "Selection and installation of 'O' rings and seals" has been added.

TABLE 9. FUEL SYSTEM

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
IDENTIFY FUEL SYSTEMS	+	–	+	+	H	H	H	H	2	3	3	3	2	3	1	3	3	3	2	3
CHECK AND SERVICE FUEL SYSTEMS AND COMPONENTS	+	–	+	+	H	H	H	H	3	3	3	3	3	3	2	3	3	3	3	3
IDENTIFY FUELS	+		+	+	H	H	H	H	2	3	1	3	2	3	1	2	3	3	3	1
SERVICE FUEL DUMP SYSTEMS	+		+	+	H	H	L	L	3	3	5	3	2	3	1	2	3	4	1	3
FABRICATE AND REPLACE LINES AND FITTINGS	$	–	+	+	H	H	H	H	3	3	3	3	3	3	3	3	3	3	3	3
INSPECT AND REPAIR FUEL SYSTEM COMPONENTS	$		+	+	H	H	H	H	4	3	3	3	4	2	3	3	4	3	3	3
REPAIR AND SEAL FUEL TANKS	–		+	+	H	H	H	L	1	3	3	3	5	3	3	3	3	4	3	3

TABLE 9

FUEL SYSTEMS

OVERVIEW OF WORK PERFORMED

The aviation mechanic services, checks, and maintains the fuel system and components. The work includes fabricating lines, inspection for fuel leaks, replacing fittings, and repairing or replacing fuel tanks and bladder cells. The inspection for fuel leaks and contamination is one of the major safety items a mechanic performs during his continual flight line checks.

PRINCIPAL FINDINGS

N - Less than 5 percent of the airline overhaul mechanics perform the tasks identified in this table.

F - General aviation mechanics do not service fuel dump systems as frequently as do airline mechanics. Mechanics employed by small general aviation companies infrequently repair and seal fuel tanks.

T - Airline line mechanics must be capable of analyzing the problem and making corrections when inspecting and repairing fuel system components.

M - Airline line mechanics inspect and repair fuel system components and repair and seal fuel tanks under critical time conditions.

I - Airline mechanics are trained in depth to service fuel dump systems, to inspect and repair fuel system components, and to repair and seal fuel tanks.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum. Training in checking, servicing, inspecting, and repairing fuel systems and components should be general and not be specifically directed to a particular airplane or system.

TABLE 10. AIR CONDITIONING AND PRESSURIZATION

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
CHECK AND SERVICE PNEUMATICS AND HEAT EXCHANGERS	+	-	+	+	H	H	H	H	3	3	3	3	3	2	3	3	3	3	3	3
INSPECT, REPLACE OR REPAIR																				
PNEUMATIC SYSTEM COMPONENTS	+	-	+	+	H	H	H	H	3	3	3	3	3	2	5	3	3	3	3	3
AIR CONDITIONING SYSTEM COMPONENTS	+	-	+	+	H	H	H	H	3	3	3	3	3	3	3	3	3	4	3	3
CHECK AND SERVICE HEAT AND COOLING SYSTEMS AND THEIR CONTROL SYSTEMS	+		+	+	H	H	H	H	3	4	3	3	3	3	3	3	3	4	3	3
CHECK AND SERVICE OXYGEN SYSTEMS	+		+	+	H	H	L	H	3	4	5	3	3	3	5	3	3	4	3	3
CHECK AND SERVICE AIRCRAFT PRESSURIZATION AND CONTROL SYSTEMS	+	-	+	$	H	H	H	H	3	3	5	3	3	3	3	3	3	4	1	1
INSPECT, REPLACE OR REPAIR																				
PRESSURIZATION SYSTEM COMPONENTS	+	-	+	$	H	H	L	H	3	3	5	3	3	2	5	3	3	3	3	1
OXYGEN SYSTEMS AND COMPONENTS	$		+	+	H	H	L	H	3	3	3	3	3	3	3	3	3	4	3	3
TROUBLESHOOT AND REPAIR AIR CONDITIONING AND PRESSURIZATION SYSTEMS	$		+	$	H	H	L	H	4	4	4	4	5	3	3	3	4	4	3	1

TABLE 10

AIR CONDITIONING AND PRESSURIZATION

OVERVIEW OF WORK PERFORMED

Air conditioning and pressurization systems are incorporated in aircraft primarily for passenger comfort while the aircraft operates at higher or more efficient altitudes. On some of the more complex aircraft, a secondary benefit derived from air conditioning is the stable, temperature-controlled environment it provides for the most efficient operation of other aircraft subsystems.

Most airline aircraft utilize complex air conditioning and pressurization systems. Aircraft are being introduced into general aviation which also incorporate these subsystems. Oxygen systems are related to air conditioning and pressurization systems; therefore, the mechanic must also be familiar with oxygen systems. These require continual, periodic checking, servicing, and troubleshooting. The mechanic must be familiar with these phases of the systems to inspect, repair, and replace system components to effect proper maintenance.

PRINCIPAL FINDINGS

N - Less than 5 percent of the airline overhaul mechanics perform the tasks identified in this table.

F - Generally, mechanics in all four categories perform work on air conditioning and pressurization systems at a high frequency.

T - The technical knowledge required of mechanics who repair air conditioning and pressurization systems is at the analysis level.

M - Airline line stations require their mechanics to work under pressure of time and do job planning to troubleshoot and repair air conditioning and pressurization systems.

I - Airline overhaul stations provide in-depth training for most of the tasks.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum. No manipulative skill training should be required under the subtopics titled "Inspect, replace, or repair: Pneumatic system components," "Inspect, replace, or repair: Pressurization system components," "Inspect, replace, or repair: Oxygen systems and components." The committee believes that few mechanics are expected to work on air conditioning or pressurization systems without additional special training.

TABLE 11. ELECTRICAL POWER

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
APPLY ELECTRON THEORY AND FUNDAMENTALS OF ELECTROMAGNETISM																				
IN READING AND ANALYZING DC AND AC CIRCUITS AND DIAGRAMS	+	-	+	+	H	H	H	H	4	3	5	3	3	3	3	3	3	4	3	3
IN OPERATION AND TESTING OF DC AND AC ELECTRICAL COMPONENTS	+	-	+	+	H	H	H	H	4	3	5	3	3	3	3	3	2	4	3	3
APPLY ELECTRICAL MEASURING AND INDICATING DEVICES FOR																				
MEASUREMENT OF VOLTAGE, CURRENT, AND RESISTANCE	+	-	+	+	H	H	H	H	3	3	2	3	3	2	3	2	3	3	3	3
CHECKING OF CONTINUITY AND ELECTRICAL LEAKAGE	+	-	+	+	H	H	H	H	3	3	3	3	3	1	2	3	3	3	3	3
PROMOTE AND PRACTICE ELECTRICAL SAFETY AND HAZARD PRECAUTIONS	+	-	+	+	H	H	H	H	3	1	3	3	3	1	2	3	4	3	3	3
APPLY ELECTRON THEORY AND FUNDAMENTALS OF ELECTROMAGNETISM																				
IN TROUBLE SHOOTING AIRCRAFT WIRING AND ELECTRICAL INSTALLATIONS	$	-	+	+	H	H	H	H	3	3	5	3	3	3	3	3	3	4	3	3
APPLY ELECTRICAL MEASURING AND INDICATING DEVICES FOR																				
CALCULATION OF RESISTANCE AND CONDUCTIVITY	$	-	+	+	H	H	H	H	3	3	5	3	2	1	3	3	4	3	2	3
CHECKING AND MEASURING CAPACITANCE	$	-	+	+	H	H	H	H	3	3	5	3	3	2	3	2	3	3	2	3
CHECKING AND MEASURING INDUCTANCE	$	-	+	+	H	H	H	H	3	3	3	3	3	2	3	3	3	3	3	3
TROUBLE SHOOT AND REPLACE DC AND AC MOTORS AND CONTROL UNITS	$	-	+	+	H	H	H	H	3	2	4	3	3	3	3	3	3	3	3	3
CHECK AND REPLACE RELAYS, SOLENOIDS, SWITCHES AND RHEOSTATS	$	-	+	+	H	H	H	H	3	2	5	3	3	2	3	3	3	3	3	3

TABLE 11

ELECTRICAL POWER

OVERVIEW OF WORK PERFORMED

Mechanics apply electrical theory in checking, servicing, and troubleshooting aircraft electrical systems. Electrical system maintenance requires a broad knowledge of the fundamentals of electricity. The effective use of measuring instruments is paramount in electrical servicing. Power generating and distribution systems contain many components, such as switches, circuit breakers, bus bars, relays, generators, inverters, regulators, etc., which require inspection, testing, and replacement where necessary. Recent developments in the electrical systems of modern aircraft have placed greater emphasis on the mechanic's ability to troubleshoot, service, and maintain the systems.

PRINCIPAL FINDINGS

F - With but one exception, checking and troubleshooting solid state switching devices by mechanics in small general aviation companies, all subtopics have a high frequency of performance by mechanics performing these tasks in all four industrial categories.

T - Many of the tasks require a technical knowledge at the analysis level by all four industrial categories. Large general aviation companies indicate that they require a technical knowledge at the synthesis level for many of the tasks. It is evident that a broad knowledge of aircraft electrical/electronic systems and subsystems is an important part of the aviation mechanic's working requirements.

M - Mechanics employed by large general aviation companies indicate that they work under time critical conditions, which require job planning, in applying electrical measuring and indicating devices for measurement and calculation of power and installing and repairing electrical wiring and distribution equipment. Airline overhaul mechanics also indicate that they require a high manipulative skill level to test and repair solid state inverters and switching devices under time critical conditions requiring job planning.

I - Although airline mechanics indicate that they receive in-depth training in some of the subtopics, industry training is generally of basic, informational content.

TABLE 11. ELECTRICAL POWER (CONTINUED)

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
CHECK AND REPLACE TRANSFORMERS, RECTIFIERS AND FILTERS	$	-	+	+	H	H	H	H	3	2	5	3	3	2	3	3	3	3	3	1
CHECK AND REPLACE ELECTRICAL PROTECTIVE DEVICES	$	-	+	+	H	H	H	H	3	2	5	3	3	2	3	3	3	3	3	3
APPLY ELECTRON THEORY AND FUNDAMENTALS OF ELECTROMAGNETISM																				
IN TROUBLE SHOOTING AIRCRAFT AC POWER SYSTEMS	-	-	+	+	H	H	H	H	4	4	4	4	3	4	3	3	4	4	3	3
IN TROUBLE SHOOTING AIRCRAFT DC POWER SYSTEMS	-	-	+	+	H	H	H	H	4	4	5	4	3	4	3	3	4	4	3	3
APPLY ELECTRICAL MEASURING AND INDICATING DEVICES FOR																				
MEASUREMENT AND CALCULATION OF POWER	-	-	+	+	H	H	H	H	3	3	5	3	3	2	5	2	3	3	3	1
CHECKING AND TESTING THERMOCOUPLES	-	-	+	+	H	H	H	H	3	3	3	3	2	3	3	3	4	3	3	3
TROUBLE SHOOT AND REPLACE DC AND AC GENERATOR EQUIPMENT	-	-	+	+	H	H	H	H	4	2	4	3	3	3	3	3	3	3	3	3
INSTALL AND REPAIR ELECTRICAL WIRING AND DISTRIBUTION EQUIPMENT	-	-	+	+	H	H	H	H	2	2	5	3	3	3	5	3	3	3	3	3
TEST AND REPAIR AIRCRAFT GENERATOR AND INVERTER CONTROL SYSTEMS	-	-	+	+	H	H	H	H	3	4	5	3	3	2	3	3	3	4	3	3
APPLY BATTERY THEORY AND TEST EQUIPMENT																				
TO MAINTAIN AND TEST LEAD ACID BATTERIES	-		+	+	H	H	H	H	3	3	3	3	1	2	2	2	3	4	3	3
TO TEST AND MAINTAIN EDISON CELLS AND NICKEL CADMIUM BATTERIES	-		+	+	H	H	H	H	3	3	3	3	2	2	2	3	3	3	3	3
TO OPERATE AND MAINTAIN BATTERY CHARGERS	-		+	+	H	H	H	H	3	3	3	3	2	2	2	2	3	3	3	3

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

The committee recommended that the subtopic, "Apply battery theory and test equipment to test and service dry battery equipment" be deleted because of extremely limited use of this equipment. All other subtopics should be included in the aviation mechanics core curriculum. It is fairly evident that a knowledge of aircraft electrical systems is becoming an important aspect of the aviation mechanic's working requirements. Although the committee was aware that the electrical and electronic work is performed by specialists in some of the aviation industries, electrical and electronics should be a part of the aviation mechanics curriculum at the application level. Committee comments and recommendations also included the following:

1) Solid state switching devices are becoming more important and finding more use in light aircraft.

2) Although AC devices are finding more use in aircraft, DC theory and devices should also be emphasized during instruction.

3) "Check and replace" tasks should all be taught at no less than Level 3.

4) The high percentage of mechanics performing the tasks in all four categories indicates the need for electrical training.

5) The student/mechanic needs a broad foundation of instruction for the installation of aircraft electrical units and wiring.

6) Industry training may be high for the subtopics because no other adequate training is received.

TABLE 11. ELECTRICAL POWER (CONTINUED--2)

	N A O L S	F A O L S	T A O L S	M A O L S	I A O L S
CHECK AND TROUBLE SHOOT SOLID STATE INVERTERS	- + +	H H H H	3 4 4 3	3 4 3 3	3 4 3 3
INSPECT, TEST AND REPAIR AIRCRAFT MOTORS, GENERATORS AND INVERTERS	- + +	H H H H	3 4 5 3	3 2 1 3	3 4 3 3
APPLY BATTERY THEORY AND TEST EQUIPMENT					
TO TEST AND SERVICE DRY BATTERY EQUIPMENT	+ +	H H H H	3 3 5 3	3 2 3 2	3 3 2 3
CHECK AND TROUBLE SHOOT SOLID STATE SWITCHING DEVICES	- $ +	H H H L	4 4 4 3	3 2 3 3	3 4 3 3
TEST AND REPAIR SOLID STATE INVERTERS AND SWITCHING DEVICES	- $ +	H H H H	3 4 4 3	3 5 3 3	2 4 3 3

TABLE 12

FLIGHT INSTRUMENTS

OVERVIEW OF WORK PERFORMED

Safe, reliable operation of the modern airplane is dependent upon the use of flight instruments. The mechanic is not only responsible for proper inspection and maintenance of the instrument systems, but he must also learn to use them for intelligent diagnosis of troubles. Mechanics service and maintain instrument systems, verify the accuracy of individual instrument indications, and replace instruments as required.

PRINCIPAL FINDINGS

N - Less than 5 percent of the airline mechanics perform the tasks identified in this table.

F - The frequency at which mechanics work with flight instruments is generally high.

I - Mechanics employed in general aviation do not receive industry training in the more complex instrument systems, while the airlines provide training in depth.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum, but the training should be adjusted to develop comprehension without a requirement for manipulative skill in the subtopic titled "Test and repair: Compasses and heading indicator systems," "Test and repair: Airspeed, rate-of-climb, and altitude indicator systems." There are indications that there will continue to be developments and refinements in instrument systems that will further improve their accuracy and reliability. These developments will demand that mechanics have a broad understanding of the instrument systems even though they do not repair the internal mechanisms of the instruments. Mechanics should be familiar with these instrument systems, test procedures, and test equipment.

TABLE 12. FLIGHT INSTRUMENTS (CONTINUED)

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
TROUBLE SHOOT AND MAINTAIN																				
ELECTRONIC INDICATING AND COMPUTING SYSTEMS	-	-	$	+	H	H	H	H	3	4	4	3	3	3	3	3	4	4	3	1
INTEGRATED TYPE OF FLIGHT INSTRUMENTATION	-	-	+	$	H	H	L	L	3	3	5	3	3	5	5	3	4	4	3	1
TEST AND REPAIR																				
ELECTRONIC COMPUTERS AND INTEGRATING SYSTEMS	-	-	+	-	H	H	H	H	3	5	5	3	3	5	3	3	4	4	3	1
SYNCHRO SYSTEMS AND MAGNETIC AMPLIFIERS	-	-	$	-	H	H	H	H	3	4	3	3	2	3	3	3	4	4	3	1

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TABLE 13. AUTO PILOTS AND APPROACH CONTROLS

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
OPERATE AND CHECK AUTO PILOT AND APPROACH CONTROL SYSTEMS	-	-	+	+	H	H	H	H	4	3	4	3	2	2	3	3	4	4	4	1
TROUBLE SHOOT AND MAINTAIN																				
FLIGHT CONTROL SERVO UNITS	-	-	+	+	H	H	H	H	4	3	5	3	3	2	4	3	4	4	4	1
CHECK AND TROUBLE SHOOT AUTO PILOT INTERLOCK SYSTEMS	-	-	+	$	H	H	H	H	4	3	5	3	2	2	2	3	4	4	3	1
TROUBLE SHOUT AND REPLACE AUTO PILOT AND APPROACH CONTROL COMPUTERS AND AMPLIFIER UNITS	-	-	$	+	H	H	H	H	4	3	4	3	2	2	3	3	4	4	4	3
TROUBLE SHOOT AND MAINTAIN																				
AUTO PILOT SIGNAL SOURCE UNITS	-	-	+	$	H	H	L	H	4	3	5	4	3	2	3	3	4	4	4	1
POWER SUPPLIES AND PHASE CONTROL	-	-	+	$	H	H	L	H	4	3	3	4	3	2	5	3	4	4	4	1
INSPECT, TEST AND REPAIR																				
AUTO PILOT CONTROL AND INTERLOCK SYSTEMS	-	-	+	$	H	H	H	H	4	3	5	3	3	2	5	3	4	4	4	3
TROUBLE SHOOT AND MAINTAIN																				
HORIZONTAL STABILIZER CONTROL AND MACH TRIM SYSTEMS	-	-	+	-	H	H	L	H	4	3	5	4	3	2	1	3	4	4	3	3
YAW DAMPER SYSTEMS	-	-	+	-	H	H	L	H	4	3	5	4	3	2	3	3	4	4	4	1
AUTO APPROACH CONTROL	-	-	+	-	H	H	H	H	4	3	4	4	3	2	3	3	4	4	4	1

TABLE 13

AUTO PILOTS AND APPROACH CONTROLS

OVERVIEW OF WORK PERFORMED

Many modern aircraft are equipped with some type of auto pilot, and the need for servicing and maintaining these systems is becoming more evident, especially in light aircraft.

Large aircraft have extremely complex auto pilot systems integrated with boosted flight control and radio approach systems.

Mechanics maintaining these systems require specialized training.

PRINCIPAL FINDINGS

N - Less then 5 percent of all airline mechanics perform the tasks identified in this table. In general, less than 10 percent of the mechanics employed by small general aviation companies work on auto pilots and approach controls.

F - The mechanics who operate, test, inspect, troubleshoot, and maintain these systems perform at high frequency.

T - Mechanics employed by the airlines at line stations and mechanics employed by large general aviation companies must have the technical knowledge to accomplish repairs at the analysis level.

I - The airlines and large general aviation companies provide training in depth to mechanics who work with these systems.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum. The committee recommended that those subtopics where the teaching is accomplished at the comprehension level not include manipulative skill training. Specialized industry training is generally provided when mechanics are assigned these tasks.

TABLE 13. AUTO PILOTS AND APPROACH CONTROLS (CONTINUED)

	N	F	T	M	I
	A O L S	A O L S	A O L S	A O L S	A O L S
INSPECT, TEST AND REPAIR					
AUTO PILOT AND APPROACH CONTROL AMPLIFIERS, COMPUTERS AND COUPLERS	- - + -	H H H H	5 5 5 3	3 5 1 3	4 4 3 1
TROUBLE SHOOT AND MAINTAIN					
GLIDE PATH EXTENSION AND RELATED DATA COMPUTERS	- - +	H H L H	4 4 5 5	3 5 3 3	4 4 4 4
INSPECT, TEST AND REPAIR					
AUTO PILOT FLIGHT CONTROL SERVOS AND DRIVE MECHANISMS	- - $ $	H H H H	3 3 4 3	3 2 3 3	4 4 4 3
AUTO PILOT SIGNAL SOURCE SYSTEMS AND UNITS	- - $ -	H H L H	3 3 4 3	3 2 3 3	4 4 4 1

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TABLE 14. AIRCRAFT COMMUNICATIONS AND NAVIGATION EQUIPMENT

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
INSPECT AND REPAIR																				
ANTENNA INSTALLATIONS	-	-	+	+	H	H	H	H	3	1	3	3	4	2	3	3	3	3	3	3
RADIO RACKS AND RELATED EQUIPMENT	-	-	+	+	H	H	H	H	3	1	3	3	4	2	3	3	3	3	3	3
RADIO AND ELECTRONIC WIRING, SWITCHING AND PROTECTIVE SYSTEMS	-	-	+	+	H	H	H	H	4	1	3	3	4	2	3	3	3	3	3	1
OPERATE AND CHECK AIRCRAFT HF AND VHF RADIO RECEIVERS AND TRANSMITTERS	-		+	+	H	H	H	H	3	2	3	3	4	3	3	3	3	3	3	1
CHECK, TROUBLE SHOOT AND REPLACE																				
VHF RECEIVER AND TRANSMITTER SYSTEMS	-		+	+	H	H	L	H	4	2	5	3	4	3	3	3	3	3	3	1
CHECK AND REPLACE																				
GYRO AND RADIO COMPASS SYSTEMS	-		+	+	H	H	H	H	3	3	3	3	4	3	3	3	3	4	4	1
ADF AND VOR SYSTEMS	-		+	+	H	H	L	H	3	3	5	3	2	3	1	3	3	4	2	1
MARKER, LOCALIZER, AND GLIDE SLOPE RECEIVERS	-		+	+	H	H	H	H	3	3	4	3	4	3	3	3	3	4	4	3
INSPECT AND REPAIR																				
CONTROL UNITS AND PANELS	-		+	+	H	H	H	H	4	3	3	3	4	3	3	3	3	3	3	1
HEADSETS, MICROPHONES, AND SPEAKERS	-		+	+	H	H	H	H	3	3	3	3	4	3	3	3	3	3	3	1
CHECK, TROUBLE SHOOT AND REPLACE																				
HF RECEIVER AND TRANSMITTER SYSTEMS	-		$	+	H	L	H	H	4	2	3	3	4	3	3	3	4	3	3	1
SERVICE AND PASSENGER COMPARTMENT INTERPHONE SYSTEMS	-		+	$	H	H	L	H	3	2	5	3	4	3	3	3	3	3	3	1

TABLE 14

AIRCRAFT COMMUNICATIONS AND NAVIGATION EQUIPMENT

OVERVIEW OF WORK PERFORMED

Mechanics are responsible for the installation of radios, antennae, navigation equipment, and associated wiring. The repair, troubleshooting, and calibration of transmitting equipment is performed by FCC licensed radio repairmen who have had additional experience with aircraft radio. Aircraft mechanics maintain the system but, when a malfunction is isolated in a unit of that system, radiomen accomplish the necessary repairs.

PRINCIPAL FINDINGS

N - Less than 5 percent of the certificated mechanics employed by the airlines work with aircraft communications and navigation equipment.

F - Most tasks identified in this table are frequently performed by mechanics in all industrial categories.

M - Mechanics employed by the airlines at line stations perform these tasks under critical time limitations.

I - Training in depth is provided by industry in some of the subtopics, while the mechanic employed by the small general aviation company generally receives no training.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

The committee recommended deleting the subtopic titled, "Check, troubleshoot and replace passenger announcement and entertainment systems" because this is a specialized system generally limited to airline operation. All other subtopics should be included in the aviation mechanics core curriculum.

TABLE 14. AIRCRAFT COMMUNICATIONS AND NAVIGATION EQUIPMENT (CONTINUED)

	N A O L S	F A O L S	T A O L S	M A O L S	I A O L S
CHECK AND REPLACE					
DME AND DMET SYSTEMS AND OFF-COURSE COMPUTERS	- + $	H H H H	3 3 5 3	2 3 3 3	3 4 4 3
WEATHER RADAR SYSTEMS	- + -	H H L H	3 3 4 1	4 3 3 3	3 4 4 1
CHECK, TROUBLE SHOOT AND REPLACE					
FLIGHT COMPARTMENT INTERPHONE SYSTEMS	- $ $	H H L H	3 2 4 3	4 3 3 3	3 3 3 1
CHECK AND REPLACE					
SELCAL AND TRANSPONDER SYSTEMS	- $ $	H H H L	3 3 4 1	4 3 3 3	4 4 4 1
CHECK, TROUBLE SHOOT AND REPLACE					
PASSENGER ANNOUNCEMENT AND ENTERTAINMENT SYSTEMS	- $ -	H H H L	3 2 3 3	4 3 3 3	3 3 3 1
CHECK AND REPLACE					
FLIGHT DIRECTORS, DATA COMPUTERS AND INTEGRATING SYSTEMS	- $ -	H H H H	3 4 4 3	4 5 3 3	3 4 4 1
LORAN, DOPPLER RADAR, RADAR ALTIMETERS	- -	H H H H	3 4 4 5	4 3 3 3	4 4 4 4
RADIO ALTIMETERS AND TERRAIN CLEARANCE INDICATION SYSTEMS	- -	H H H L	3 4 4 3	4 4 3 3	4 4 4 3
FLIGHT RECORDERS	-	H H H L	3 2 4 3	4 3 3 3	3 4 4 1

TABLE 15. ENGINE INSTRUMENTS, ELECTRICAL

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
INSPECT, TEST AND REPAIR																				
ELECTRICAL CONNECTIONS AND WIRING	$	-	+	+	H	H	H	H	3	1	3	3	2	3	3	3	2	2	3	3
INSTRUMENT PANELS AND UNIT MOUNTINGS	-	-	+	+	H	H	H	H	3	1	3	3	2	3	2	3	3	2	3	3
TROUBLE SHOOT AND REPLACE																				
PRESSURE INDICATION SYSTEMS	-		+	+	H	H	H	H	3	2	3	3	2	3	3	3	3	3	3	1
TEMPERATURE INDICATION SYSTEMS	-		+	+	H	H	H	H	3	2	3	3	2	2	3	3	3	3	3	1
TACHOMETERS AND RPM INDICATORS	-		+	+	H	H	H	H	3	4	3	3	2	4	3	3	4	3	3	3
INSPECT, TEST AND REPAIR																				
ENGINE INDICATING SYSTEM COMPONENTS	-		+	+	H	H	H	H	3	4	3	3	2	4	3	3	4	3	3	1
TROUBLE SHOOT AND REPLACE																				
RATE-OF-FLOW INDICATION SYSTEMS	-		+	+	H	H	H	H	3	4	3	3	2	4	3	3	4	3	3	1

TABLE 15

ENGINE INSTRUMENTS, ELECTRICAL

OVERVIEW OF SYSTEM AND WORK PERFORMED

Engine electrical instruments serve to provide the flight crew with engine operating parameters so that they may ascertain or select engine conditions at any time. Mechanics are responsible for the installation, electrical connection, removal, servicing, and checking of tachometers, temperature indicators, and fuel flow indicators. Checking includes the inspection of physical condition, operation, and calibration of the instruments. Although the mechanic may be limited in performing field repairs on these instruments, specially trained repairmen are employed by instrument repair shops to overhaul, repair, and test the instruments.

PRINCIPAL FINDINGS

N - Less than 10 percent of the airline mechanics work on these instrument systems.

F - The frequency with which mechanics work on electrical engine instruments is high in all industrial categories.

T - Airline overhaul stations indicate that the technical knowledge required to troubleshoot and replace tachometers and rate-of-flow indication systems and to inspect, test, and repair engine indicating system components is at the analysis level.

M - Airline overhaul stations indicate that the mechanic works under a time critical situation that requires no job planning for these same tasks.

I - Airline line stations provide in-depth training for these same tasks, although industry generally provides training at the basic or general information level.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum. In addition, the committee recommended that another subtopic titled "Inspect, test and repair electrical connectors" be added to the core curriculum. It was generally agreed that this added subtopic is often neglected and that its importance justifies its inclusion in the core curriculum. This new subtopic is listed in the core curriculum on page 183.

TABLE 16. AIRCRAFT FUEL AND OIL MEASUREMENT AND CONTROL

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
PERFORM FUEL MANAGEMENT, TRANSFER AND DEFUELING	+	–	+	+	H	H	H	H	3	4	3	3	3	3	3	3	3	4	3	3
TROUBLE SHOOT AND REPLACE																				
FUEL AND OIL ELECTRIC PUMPS, VALVES AND THEIR CONTROLS	$	$	+	+	H	H	H	H	3	2	3	3	4	3	3	3	3	3	3	3
FLUID QUANTITY INDICATION SYSTEMS	–	–	+	+	H	H	H	H	3	4	3	3	2	3	3	3	4	4	3	3
FLUID PRESSURE AND TEMPERATURE INDICATION SYSTEMS	–	–	+	+	H	H	H	H	3	3	3	3	2	3	3	3	3	3	3	3
FLUID SYSTEM WARNING DEVICES	–	–	+	+	H	H	H	H	3	2	3	3	2	3	3	3	3	4	3	3
CALIBRATE AND TEST																				
CAPACITANCE FUEL AND OIL QUANTITY INDICATION SYSTEMS	–	–	+	+	H	H	H	H	3	4	3	3	2	3	3	3	4	4	3	1
FLOAT TYPE FUEL AND OIL QUANTITY INDICATION SYSTEMS		–	+	+	H	H	H	H	3	2	3	3	3	3	3	3	3	3	3	3
INSPECT AND REPAIR																				
FUEL AND OIL PUMPS, VALVES AND OTHER CONTROL UNITS		–	+	+	H	H	H	H	5	3	3	3	4	2	3	3	4	3	3	3
FLUID QUANTITY INDICATION EQUIPMENT	–		+	+	H	H	H	H	3	4	3	3	2	4	3	3	4	3	3	3
PRESSURE AND TEMPERATURE INDICATION AND WARNING SYSTEMS	–		+	+	H	H	H	H	3	4	3	3	2	4	3	3	3	3	3	3
TROUBLE SHOOT AND REPLACE																				
PRESSURE REFUELING CONTROL EQUIPMENT	–	–	+	$	H	H	H	L	3	3	3	3	4	3	3	3	3	4	3	3

TABLE 16

AIRCRAFT FUEL AND OIL MEASUREMENT AND CONTROL

OVERVIEW OF WORK PERFORMED

Mechanics must be familiar with fuel and oil pumps, valves and controls, quantity indication systems, warning systems, pressure- and temperature-indicating systems, refueling and defueling systems, and fuel transfer systems. They are required to have this knowledge because they are regularly called upon to service and maintain this equipment. In addition, mechanics must be able to troubleshoot these systems, perform necessary repairs, and conduct routine inspections. Mechanics performing calibration tests on fluid quantity indication systems must exercise utmost care in preventing foreign objects from entering and remaining in fuel or oil tanks. Mechanics remove, install, and repair components of these systems and must be familiar with the mechanical rigging required between controls, valves, and switches.

PRINCIPAL FINDINGS

N - Less than 5 percent of the airline mechanics perform most of these tasks.

F - The rate of frequency with which mechanics work on aircraft fuel and oil measurement and control equipment is high in all categories.

T - Airline line stations indicate that the technical knowledge of mechanics should be at the synthesis level for inspecting and repairing fuel and oil pumps, valves, and other control units. Airline overhaul mechanics perform many of these tasks at the analysis level.

I - Training in depth is offered by the airline industry in many of the subtopics.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum. The committee recommended deleting manipulative skill training from these subtopics,"Inspect and repair fluid quantity indication equipment," and "Troubleshoot and replace pressure refueling control equipment." These recommendations are made on the basis of equipment availability and costs involved. An overview lecture on these subtopics is considered to be adequate.

TABLE 17. AIRCRAFT LANDING GEAR ELECTRICAL UNITS

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
TROUBLE SHOOT LANDING GEAR POSITION INDICATION AND WARNING SYSTEMS	-	-	+	+	H	H	H	H	3	3	4	3	2	5	3	3	3	4	3	3
CHECK AND TROUBLE SHOOT GROUND—FLIGHT CHANGEOVER SWITCHES AND RELAYS	-	-	+	+	H	H	H	H	3	3	4	3	2	5	3	3	3	4	3	3
CHECK TAKEOFF WARNING SYSTEMS	-	-	+	+	H	H	H	H	3	3	4	3	2	2	3	2	3	4	3	3
INSPECT, TEST AND REPLACE																				
SPEED WARNING COMPONENTS	-	-	+	+	H	H	H	H	3	3	4	3	2	3	3	3	3	4	3	3
TAKE-OFF WARNING COMPONENTS	-	-	+	+	H	H	H	H	3	3	4	3	2	3	3	3	3	4	3	1
LANDING GEAR AND GEAR DOOR SWITCHES	-	-	+	+	H	H	H	H	3	3	3	3	2	3	3	3	3	4	3	3
GROUND-FLIGHT SWITCHES AND RELAYS	-	-	+	+	H	H	H	H	3	3	3	3	2	3	3	3	3	4	3	1
CHECK AND TROUBLE SHOOT ELECTRICAL BRAKE CONTROLS AND ANTI-SKID CONTROL SYSTEMS	-	-	+	$	H	H	H	H	3	4	4	3	2	2	3	3	3	4	3	1
INSPECT, TEST AND REPLACE																				
ANTI-SKID CONTROL COMPONENTS	-	-	+	-	H	H	H	H	3	3	4	3	2	3	3	3	3	4	3	3

TABLE 17

AIRCRAFT LANDING GEAR ELECTRICAL UNITS

OVERVIEW OF WORK PERFORMED

Mechanics inspect, service, and repair aircraft landing gear retract systems, warning systems, and position indicators. The electrical control of retractable landing gear and anti-skid devices must operate perfectly if serious aviation accidents are to be prevented. The testing and replacement of warning systems, change-over relays, and landing gear position indicators are but a few of the tasks performed.

PRINCIPAL FINDINGS

N - Less than 5 percent of the airline industry mechanics perform these tasks.

F - The frequency at which aviation mechanics work with landing gear electrical units is high.

T - Mechanics employed by large general aviation companies indicate that they must analyze system malfunctions and troubleshoot most of the tasks identified in this table.

M - Airline overhaul mechanics indicate that troubleshooting landing gear indication and position warning systems, along with flight change-over switches and relays, requires job planning under critical time conditions.

I - Airline mechanics employed at the overhaul bases are trained in depth in all subtopics.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

The committee recommended that the inspection, testing, and replacement of anti-skid control components be deleted from the aviation mechanics core curriculum because of specialization and high cost of equipment. All other subtopics should be included. The teaching level for the subtopic titled "Check takeoff warning systems" need not include manipulative skill training.

TABLE 18. FIRE DETECTION AND EXTINGUISHING SYSTEMS

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
CHECK AND SERVICE																				
BIMETALLIC, THERMOCOUPLE AND CONTINUOUS STRIP FIRE DETECTION SYSTEMS	$	-	+	+	H	H	H	H	1	3	3	3	2	3	3	3	3	4	3	3
FIRE EXTINGUISHING SYSTEMS	$	-	+	+	H	H	H	H	1	3	3	3	2	3	3	3	3	4	3	1
INSPECT, REPLACE OR REPAIR																				
COMPARTMENT FIRE DETECTORS AND SYSTEM COMPONENTS	$	-	+	+	H	H	H	L	2	3	3	3	3	3	2	3	3	3	3	3
FIRE EXTINGUISHERS AND RELATED SYSTEM COMPONENTS	$	-	+	+	H	H	H	H	3	3	3	3	3	2	2	3	3	4	3	3
ENGINE AND NACELLE FIRE DETECTION COMPONENTS	-	-	+	+	H	H	H	L	2	3	3	3	2	3	2	3	3	3	3	3
CHECK AND SERVICE																				
SMOKE AND CARBON MONOXIDE DETECTION SYSTEMS	$		+	$	H	H	H	L	1	3	3	3	2	4	3	3	3	3	3	3
INSPECT, REPLACE OR REPAIR																				
SMOKE DETECTION COMPONENTS	$		+	-	H	H	H	H	3	3	3	4	3	5	3	3	2	4	3	3

TABLE 18

FIRE DETECTION AND EXTINGUISHING SYSTEMS

OVERVIEW OF SYSTEMS AND WORK PERFORMED

Fire detection and extinguishing systems require periodic servicing, checking, and maintenance. The mechanic must be familiar with the operation of these systems so that he may perform necessary inspection of all components, such as valves, sensors, indicators, extinguishing material containers, electrical wires, and plumbing. These systems also require troubleshooting in the event of a component malfunction, and the mechanic should be familiar with installation, removal or replacement procedures, and operational checking of the system or components.

PRINCIPAL FINDINGS

N - Less than 5 percent of airline overhaul mechanics accomplish these tasks.

F - Airline mechanics and mechanics employed by large general aviation companies perform work on fire detection and extinguishing systems at a high rate of frequency. Mechanics employed by small general aviation companies perform these tasks at a lower rate of frequency, since most light aircraft do not incorporate fire detection and extinguishing systems.

T - Airline line stations indicate that they require the technical knowledge of mechanics to be only at the knowledge level for checking and servicing these systems.

M - Airline overhaul stations indicate that time is critical and job planning is required to accomplish the task of inspecting, replacing, or repairing smoke detection components.

I - Airline overhaul stations provide in-depth training in most of the subtopics, while industry generally provides training at the basic or general information level.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum. Manipulative skill training is not recommended for checking and servicing fire exting··ishing systems. The committee recommended that a technical overview lesson on this subject be provided. The committee believed that specific knowledge of an individual system would not be as beneficial to the student as a broad technical lecture/discussion of this subject.

TABLE 19. ICE AND RAIN CONTROL

	N	F	T	M	I
	A O L S	A O L S	A O L S	A O L S	A O L S
CHECK AND SERVICE					
POWERPLANT ICE CONTROL SYSTEMS	$ - + +	H H H H	4 3 3 3	4 2 2 3	2 4 3 3
AIR SCOOPS AND LEADING EDGE ICE CONTROL SYSTEMS	$ - + +	H H H H	4 3 3 3	4 2 2 2	2 4 3 3
ELECTRICAL WINDSHIELD ICE CONTROL SYSTEMS	$ - + +	H H H L	3 3 3 3	4 4 2 3	4 4 3 1
INSPECT AND REPAIR					
POWERPLANT ICE CONTROL COMPONENTS	$ + +	H H H H	4 3 3 3	3 2 2 3	3 4 3 3
CHECK AND SERVICE					
ANTENNAS, ACCESSORIES AND PITOT STATIC DEVICES	- - + +	H H H H	3 3 3 3	2 4 2 3	3 4 3 3
TROUBLE SHOOT AND REPAIR WINDSHIELD RAIN REMOVAL AND WINDOW DEFOGGING SYSTEMS	- - + +	H H H H	4 3 3 3	5 2 3 3	3 4 3 1
INSPECT AND REPAIR					
AIR SCOOPS AND LEADING EDGE ICE CONTROL SYSTEMS	- - + +	H H H H	4 3 3 3	3 2 2 3	3 4 3 1
WINDSHIELD ICE CONTROL SYSTEMS	- + +	H H H L	4 2 3 3	4 2 2 3	3 2 3 1
CHECK AND SERVICE					
PNEUMATIC WINDSHIELD ANTI-ICING AND DEFOGGING SYSTEMS	+ +	H H H H	3 3 3 3	3 2 2 3	2 4 3 1

TABLE 19

ICE AND RAIN CONTROL

OVERVIEW OF WORK PERFORMED

Both anti-icing and de-icing systems are essential to air safety. Mechanics service, maintain, and check out these systems. Ice and rain control systems include pneumatic de-icer boots; thermal anti-icing; parting strip heaters; calrod heaters on scoops, etc.; powerplant ice control; and windshield de-fogging and de-icing equipment. Ice detectors are also serviced.

PRINCIPAL FINDINGS

N - Less than 10 percent of all airline mechanics perform these tasks.

F - Mechanics employed by small general aviation companies rarely service electrically heated windshields.

T - Airline line mechanics generally work at the analysis level.

M - Airline mechanics are under time limitations when performing many of the tasks identified in this table.

I - Airline overhaul mechanics receive industry training in depth in the majority of these subtopics. Mechanics employed by small general aviation companies receive little training in this subject area.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum, but the subtopic titled "Check and service powerplant ice control systems" need not include manipulative skill training. The committee believed that specific knowledge of an individual system would not be as beneficial to the student as a broad technical lecture/discussion of this subject.

TABLE 20. WARNING SYSTEMS

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
CHECK AND SERVICE																				
HYDRAULIC POWER AND SYSTEM COMPONENTS	-	-	+	+	H	H	H	H	3	3	3	3	2	3	2	3	3	4	3	3
ICE AND RAIN PROTECTION	-	-	+	+	H	H	H	H	3	3	3	3	2	3	2	2	3	4	3	1
LIGHTS AND LIGHTING	-	-	+	+	H	H	H	H	3	3	3	3	2	3	2	2	3	4	3	3
DOORS AND EMERGENCY WINDOWS	-	-	+	+	H	H	H	H	3	3	3	3	2	3	2	2	3	4	3	3
FLIGHT CONTROLS, FLAPS, SPOILERS AND LEADING EDGE DEVICES	-	-	+	+	H	H	H	H	3	3	3	3	2	3	3	3	3	4	3	3
POWERPLANT STARTING AND VIBRATION	-	-	+	+	H	H	H	H	3	3	3	3	3	3	2	3	3	4	3	3
OVERSPEED AND UNDERSPEED	-	-	+	+	H	H	H	L	3	3	3	3	2	3	2	3	3	4	3	3
ELECTRICAL, PNEUMATIC AND OXYGEN SYSTEMS	-	-	+	+	H	H	H	H	3	3	3	3	2	3	3	3	3	4	3	3
INSPECT AND REPAIR WARNING SYSTEM COMPONENTS			+	+	H	H	H	H	4	3	3	3	4	2	3	3	4	4	3	3

TABLE 20

WARNING SYSTEMS

OVERVIEW OF WORK PERFORMED

A warning system may give flight crews or pilots their first indication of a malfunction. Significant is the growing availability of small, fast piston- and turbine-powered aircraft in the general aviation fleet, which incorporate warning systems. Mechanics service and repair warning systems, such as door warning; power failure warning; fuel, oil and hydraulic low pressure warning; stall warning; and over- or under-speed warning. Some aircraft employ vibration detection indicators.

PRINCIPAL FINDINGS

N - Less than 5 percent of all airline mechanics perform these tasks.

F - In all categories, their mechanics perform these tasks at a high rate of frequency.

M - Airline line station mechanics may be required to inspect and repair warning system components under critical time limitations.

I - Airline overhaul mechanics are trained in depth in all subtopics. Airline line mechanics are trained in depth to inspect and repair warning system components.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum. The committee recommended teaching to the comprehension level for all subtopics except "Inspection and repair of warning system components" where teaching to the knowledge level would be adequate.

TABLE 21. RECIPROCATING ENGINES

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
IDENTIFY TYPES AND PRINCIPLES OF RECIPROCATING POWERPLANTS	+	-	+	+	H	H	H	H	1	3	3	3	2	5	1	3	4	3	4	1
CHECK AND SERVICE																				
FOURTEEN CYLINDER RADIAL ENGINE OR LARGER	+		+	+	H	H	H	H	1	4	3	3	3	5	3	3	3	4	4	3
INSPECT AND REPAIR																				
FOURTEEN CYLINDER RADIAL ENGINE OR LARGER	+		+	+	H	H	H	H	4	4	4	3	3	5	3	3	3	4	4	3
REMOVE AND INSTALL ENGINE	+		+	+	L	H	H	H	3	3	3	3	3	5	3	3	4	4	3	3
CHECK AND SERVICE																				
CYLINDER	$		+	+	H	H	H	H	2	4	3	3	3	5	3	3	3	4	3	3
INSPECT AND REPAIR																				
CYLINDER	$		+	+	H	H	H	H	4	4	4	3	3	5	3	3	4	4	3	3
GEAR REDUCTION SECTION	-		+	+	H	H	H	H	1	4	4	3	2	5	3	3	4	4	3	3
SUPERCHARGER	-		+	+	H	H	H	H	3	4	4	3	3	5	3	3	4	4	3	3
TROUBLE SHOOT	-		+	+	H	H	H	H	3	4	4	3	3	5	3	3	4	4	3	3
OPERATE ENGINE	-		+	+	H	H	H	H	3	4	3	3	4	5	3	3	4	4	3	3
INSPECT AND REPAIR																				
FOUR OR SIX CYLINDER OPPOSED ENGINE			+	+			H	H			3	3			3	3			3	3
SEVEN OR NINE CYLINDER RADIAL ENGINE			+	+			H	H			3	3			3	3			3	3

TABLE 21

RECIPROCATING ENGINES

OVERVIEW OF WORK PERFORMED

Since the advent of aviation, reciprocating engines have undergone innumerable changes to achieve their present reliability. Although turbine engines are now finding more and varied use in aviation, the reciprocating engine is still in great demand. The aviation mechanic must understand the theory of reciprocating engine operation and possess the maintenance skills needed to maintain these aircraft powerplants. He must be capable of operating, interpreting trouble reports, servicing, troubleshooting, and overhauling these engines.

PRINCIPAL FINDINGS

N - Less than 2 percent of airline overhaul mechanics work on reciprocating engines.

F - Mechanics working on reciprocating engines perform their jobs at a high rate of frequency. Airline line mechanics infrequently remove and install reciprocating engines. Radial engines of seven or more cylinders are overhauled infrequently by small general aviation companies. The airline mechanics, on the other hand, do not work with small reciprocating engines.

M - Airline overhaul mechanics work under critical time limitations requiring job planning. Airline mechanics generally receive training in depth regarding cylinders, gear reduction sections, superchargers, and troubleshooting and operating reciprocating engines. Large general aviation offers training in depth for the overhaul of all reciprocating engines.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum. The subtopic "Identify types and principles of reciprocating powerplants" should not include manipulative skill.

TABLE 21. RECIPROCATING ENGINES (CONTINUED)

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
CHECK AND SERVICE																				
GEAR REDUCTION SECTION			+	+	H	H	H	H	1	4	3	3	2	3	3	3	3	4	3	3
SUPERCHARGER			+	+	H	H	H	H	1	4	3	3	2	3	3	3	3	4	3	3
FOUR OR SIX CYLINDER OPPOSED ENGINE			+	+			H	H			3	3			3	3			3	3
SEVEN OR NINE CYLINDER RADIAL ENGINE			+	+			H	H			3	3			3	3			3	3
OVERHAUL																				
FOUR OR SIX CYLINDER OPPOSED ENGINE			+	+			H	H			3	3			3	3			4	3
SEVEN OR NINE CYLINDER RADIAL ENGINE			+	+			H	L			3	3			3	3			4	3
CYLINDER			+	+	H	H	H	H	3	4	3	3	3	5	3	3	4	4	4	3
GEAR REDUCTION SECTION			$	+	H	H	H	L	3	4	3	3	3	5	3	3	4	4	4	3
SUPERCHARGER			$	+	H	H	H	L	3	3	3	3	3	5	3	3	4	3	4	4
FOURTEEN CYLINDER RADIAL ENGINE OR LARGER			$	$		H	H	L		3	3	3		5	3	3		3	4	1

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TABLE 22. TURBINE ENGINES

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
IDENTIFY TYPES AND PRINCIPLES OF TURBINE ENGINES	+	-	+	+	H	H	H	H	3	5	3	3	3	5	1	1	4	3	3	1
REMOVE AND INSTALL ENGINE	+	-	+	+	H	H	H	L	4	3	3	3	5	5	3	3	4	4	3	1
INSPECT AND REPAIR TURBOJET	+	+	+	-	H	H	H	H	5	4	3	3	3	3	3	3	3	4	3	3
CHECK AND SERVICE ACCESSORIES	+	-	+	$	H	H	H	H	3	3	3	3	3	4	3	3	3	4	4	4
INSPECT AND REPAIR ACCESSORIES	+		+	$	H	H	H	H	3	4	3	3	5	4	3	3	3	3	4	4
CHECK AND SERVICE TURBOJET	+	-	+	-	H	H	H	H	3	3	3	3	3	3	3	3	3	4	3	3
TROUBLE SHOOT	$		+	$	H	H	H	H	4	4	4	3	4	5	3	3	4	4	4	4
OPERATE ENGINE	$		+	$	H	H	H	H	3	4	3	3	5	4	3	3	3	4	4	4
CHECK AND SERVICE TURBOFAN	+	-	$	-	H	H	H	H	3	3	2	3	3	3	3	3	3	4	4	3
OVERHAUL TURBOJET	$	+	-		H	H	L	H	5	4	4	3	3	5	4	3	4	4	3	3
CHECK AND SERVICE TURBOPROP			+	$	H	H	H	H	1	4	3	3	2	5	3	5	3	4	4	4
INSPECT AND REPAIR TURBOPROP			+	$	H	H	H	H	1	4	3	3	2	5	3	5	3	4	4	4
INSPECT AND REPAIR TURBOFAN	+		$		H	H	H	H	5	4	3	3	3	5	3	3	3	4	4	3
OVERHAUL TURBOFAN	$	-	-		H	H	L	H	5	1	4	3	3	5	4	3	4	3	3	3
OVERHAUL ACCESSORIES	-		-		H	H	L	H	5	5	4	3	3	5	4	3	4	4	4	3
OVERHAUL TURBOPROP				-		H	H	H		5	4	5		5	5	3		4	4	4

TABLE 22

TURBINE ENGINES

OVERVIEW OF WORK PERFORMED

The basic turbine engine and its operation is quite simple when compared to the reciprocating engine. Because of this simplicity, the turbine engine generally requires less maintenance and operates for greater periods of time between overhauls than does the reciprocating engine. The servicing of turbine engines can be more critical than reciprocating engines because of their characteristic operation at higher temperatures, pressures, speeds and power. The mechanic must know how to operate, troubleshoot, interpret discrepancy reports, service, and maintain these engines and their accessories. As more turbine engines are being introduced into aviation, the demand for more mechanics trained in turbine engines correspondingly increases.

PRINCIPAL FINDINGS

N - Less than 2 percent of airline mechanics check and service, inspect and repair, and overhaul turboprop engines.

F - The frequency at which mechanics work with turbine engines is high. Comparison of the results of this study with those of the California study conducted one year earlier indicates a heavy increase in the number of turbine engines now being used in general aviation.

T - General aviation indicated that the technical knowledge needed by mechanics is mostly at the application level, while the airlines indicated that the level was more at the analysis/synthesis level.

M - Many of the tasks are performed under pressure of time, and the mechanics are required to plan their job steps prior to performing them.

I - In-depth training is provided by all industrial categories in the troubleshooting of turbine engines in particular.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum. The subtopic "Identify types and principles of turbine engines" should not include manipulative skill training. The committee recommended that the overhaul of turbine engines during instruction may utilize parts and materials that would be adequate for the training situation but would not necessarily require that the engine be assembled to a return to flight condition. This does not mean that the quality of workmanship should be less than return to flight standards.

TABLE 23. LUBRICATING SYSTEMS

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
IDENTIFY TYPES OF LUBRICATION SYSTEMS	+	–	+	+	H	H	H	H	3	2	1	3	3	3	1	2	3	3	3	3
IDENTIFY TYPES AND SPECIFICATIONS OF LUBRICANTS	+	–	+	+	H	H	H	H	2	2	1	3	2	3	1	3	3	3	3	3
CHECK AND SERVICE																				
COOLERS AND TEMPERATURE REGULATORS	+	–	+	+	H	H	H	H	2	3	3	3	3	3	2	3	3	3	3	3
PUMPS AND VALVES	+	–	+	+	H	H	H	H	2	3	3	3	3	3	2	3	3	3	3	3
SEALS AND OTHER COMPONENTS	+	–	+	+	H	H	H	H	2	3	3	3	3	3	2	2	3	3	3	3
TANKS AND LINES	+	–	+	+	H	H	H	H	2	3	3	3	3	3	2	3	3	3	3	3
INSPECT AND REPAIR																				
COOLERS AND TEMPERATURE REGULATORS	+	–	+	+	H	H	H	H	2	3	3	3	3	3	2	3	3	3	4	3
PUMPS AND VALVES	+	–	+	+	H	H	H	H	2	3	3	3	3	3	3	3	3	3	4	3
TANKS AND LINES	+	–	+	+	H	H	H	H	2	3	3	3	3	3	3	3	3	3	3	3
SEALS AND OTHER COMPONENTS	+		+	+	H	H	H	H	2	3	3	3	3	5	3	3	3	3	3	3
ADJUST PRESSURE	+		+	+	H	H	H	H	3	4	3	3	2	3	3	3	3	4	3	3
INSPECT AND REPAIR																				
OIL DILUTION SYSTEM	–		+	+	H	H	H	L	3	3	3	3	3	3	2	3	3	3	3	3
CHECK AND SERVICE																				
OIL DILUTION SYSTEM	–		+	+	H	H	H	L	3	3	3	3	3	3	2	3	3	4	3	3

TABLE 23

LUBRICATING SYSTEMS

OVERVIEW OF WORK PERFORMED

Lubricating systems of both reciprocating and turbine engines must be maintained and serviced by mechanics. Such systems include engine components, accessories, coolers (radiators), tanks, lines, etc. The proper maintenance of the lubricating system will assist in providing normal engine operating temperatures and pressures so that the operating life of the powerplant is extended.

PRINCIPAL FINDINGS

N - Less than 5 percent of airline overhaul mechanics work on lubricating systems.

F - It will be noted that mechanics work on the lubricating systems at high frequency.

T - The technical knowledge level required by the airline line stations is generally at the comprehension level. The technical knowledge level required by airline overhaul stations and general aviation is primarily at the application level.

M - Airline overhaul stations indicate that time is critical and that the mechanic must utilize job planning during his task of inspecting and repairing seals and other components.

I - In most of the tasks performed, industry training is at the basic or general information level. Large general aviation provides training in depth for the inspection and repair of coolers and temperature regulators, pumps and valves, while airline overhaul stations provide in-depth training for adjusting pressure and checking and servicing oil dilution systems.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum.

TABLE 24. IGNITION SYSTEMS

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
IDENTIFY SPECIAL DANGERS OF HIGH ENERGY SYSTEMS	+	+	+	+	H	H	H	H	4	3	3	3	3	1	3	3	3	3	4	1
CHECK AND SERVICE																				
TURBINE IGNITION SYSTEMS	+		+	+	H	H	H	H	4	3	3	3	3	4	2	3	3	3	3	1
LOW TENSION SYSTEMS	$		+	+	H	H	H	H	3	3	3	3	3	5	2	3	3	4	3	3
INSPECT AND REPAIR																				
LOW TENSION SYSTEMS	$		+	+	H	H	H	H	3	4	4	3	3	3	3	3	3	4	3	3
BOOSTER STARTING SYSTEMS	$		+	+	H	H	H	H	3	3	3	3	3	3	2	3	3	4	3	1
TURBINE IGNITION SYSTEMS	+		+	$	H	H	H	H	4	3	3	3	3	3	3	3	3	4	4	4
CLASSIFY TYPES OF MAGNETOS	-		+	+	H	H	H	H	3	3	1	3	3	1	1	3	4	4	3	1
CHECK AND SERVICE																				
BOOSTER STARTING SYSTEMS	-		+	+	H	H	H	H	1	2	3	3	2	2	2	3	3	3	3	3
BATTERY IGNITION SYSTEMS			+	+	H		H	L	3		3	3	3		2	3	4		3	3
HIGH TENSION SYSTEMS			+	+	H		H	H	1		3	3	3		2	3	2		3	3
INSPECT AND REPAIR																				
BATTERY IGNITION SYSTEMS			+	+	H		H	L	3		3	3	3		3	3	4		3	3
HIGH TENSION SYSTEMS			+	+	H		H	H	1		3	3	2		3	3	3		3	3

TABLE 24

IGNITION SYSTEMS

OVERVIEW OF WORK PERFORMED

Ignition systems consist of high energy producing devices, magnetos, booster coils, spark plugs, distributors, and harnesses. These components require maintenance in the form of repairs, servicing, removal, proper timing, and installation associated with reciprocating and/or turbine engines.

PRINCIPAL FINDINGS

N - With the exception of identifying special dangers of high energy systems, less than 2 percent of airline overhaul mechanics work on ignition systems.

F - With the exception of airline overhaul mechanics who do not check, service, inspect or repair battery ignition and high tension systems, mechanics in all categories work on ignition systems at high frequency.

T - Mechanics employed at airline line stations indicate that the technical knowledge for turbine ignition systems is at the analysis level.

I - Airline overhaul stations provide in-depth training to their mechanics in ignition systems, with the exception of battery and high tension ignition systems where no training is provided.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics, except "Classify types of magnetos," "Check and service battery ignition systems," and "Inspect and repair battery ignition systems," should be included in the aviation mechanics core curriculum. The identified subtopics have been recommended for deletion on the basis of obsolescence and the basis that the time would be better spent in the teaching of turbine engine ignition systems.

TABLE 25. FUEL METERING

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
INSPECT, MAINTAIN, AND TEST																				
GAS TURBINE FUEL CONTROL UNITS	+		+	+	H	H	H	H	4	3	3	3	3	4	3	3	3	4	4	1
ADI SYSTEMS	$		+	+	L	H	H	H	3	3	3	3	3	3	2	3	3	3	4	1
CARBURETOR DE-ICING AND ANTI-ICING	$		+	+	H	H	H	H	3	3	3	3	3	3	2	3	3	3	3	3
CHECK AND SERVICE WATER INJECTION SYSTEM	+		+	$	H	H	H	H	4	4	1	3	3	4	2	3	3	4	3	3
DETERMINE CAUSES OF DETONATION, AUTO IGNITION, ETC.	-		+	+	H	H	H	H	3	3	4	3	4	1	3	3	3	4	3	1
INSPECT, MAINTAIN, AND TEST																				
FLOAT CARBURETORS	-		+	+	L		H	H	3		3	3	3		3	3	3		3	3
INJECTION CARBURETORS	-		+	+	L	H	H	H	3	1	3	3	3	3	3	3	3	4	4	3
INJECTION NOZZLES	-		+	+	L	H	H	H	3	1	3	3	3	3	2	3	3	4	4	3
TRIM TURBINE POWERPLANTS	$		+	$	H	H	H	L	3	3	4	3	5	3	3	3	4	4	4	3

TABLE 25

FUEL METERING

OVERVIEW OF WORK PERFORMED

Fuel metering systems for reciprocating and turbine engines basically consist of fuel tanks, pumps, fuel controls, pressurizing and drain valves, carburetors or master controls, water injection controls, de-icing and anti-icing systems, injection nozzles, and associated plumbing.

Mechanics inspect, service, and maintain these fuel metering and carburetion systems. Generally, fuel metering and control systems are quite complex, with the fuel metering and control components requiring special test equipment for proper calibration. Mechanics do not repair fuel control units in the field, but they must understand the operation of and be capable of troubleshooting the fuel metering system on a turbine or reciprocating engine.

PRINCIPAL FINDINGS

N - Less than 2 percent of airline overhaul mechanics work on fuel metering systems.

F - Except for airline line station mechanics, who infrequently work on carburetors, injection nozzles, and anti-detonant injection systems, mechanics in all categories work at a high rate of frequency in the areas of fuel metering. Mechanics employed by small aviation companies work at a low rate of frequency in the area of "trimming" turbine powerplants. (This will increase with the introduction of greater numbers of turbine engine aircraft in general aviation.)

T - The technical knowledge required by airline line stations for "Inspect, maintain, and test gas turbine fuel control units" and all airline mechanics when checking and servicing water injection systems is at the analysis level. The same knowledge level is required by large general aviation for "trim turbine powerplants" and determining causes of detonation, auto ignition, etc.

I - Training in depth is given by airline overhaul stations and large general aviation in the areas of gas turbine fuel control units, injection carburetors and nozzles, and the trimming of turbine powerplants.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum.

TABLE 26. INDUCTION SYSTEM

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
INSPECT AND MAINTAIN																				
CARBURETOR INTAKE AND INTAKE PIPES	$		+	+	H	H	H	H	3	3	3	3	3	2	2	3	3	3	3	3
HEAT EXCHANGERS	$		+	+	L	H	H	H	3	3	3	3	3	2	2	3	3	3	3	3

TABLE 26

INDUCTION SYSTEM

OVERVIEW OF WORK PERFORMED

The induction system generally refers to reciprocating engines and consists of air intake scoops, pipes, superchargers, and heat exchangers.

Mechanics perform inspection, installation, removal, and maintenance of the induction system. Maintenance includes checking the system for security and leakage to prevent fires and for improper operation of the engine.

PRINCIPAL FINDINGS

N - Less than 2 percent of airline overhaul mechanics work on induction systems.

F - Except for the inspection and maintenance of heat exchangers by airline line stations, the rate of frequency for mechanics performing induction system tasks is high in all categories.

T - The technical knowledge required for all categories is at the application level.

M - Airline line stations and small general aviation show a manipulative skill level where the mechanic has a reasonable time limit and requires job planning to perform the tasks on the induction system.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum.

TABLE 27. PROPELLER (GENERAL)

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
PERFORM SPECIALIZED PROPELLER INSPECTIONS	-		+	+	H	H	L	H	3	3	4	3	2	5	3	3	3	4	4	3
PERFORM PROPELLER TRACK	-		+	+	H	L	L	H	3	4	3	3	4	3	2	3	3	3	3	3
USE UNIVERSAL PROTRACTOR	-		+	+	H	H	H	H	3	3	3	3	4	3	3	3	3	4	3	3
APPLY THEORY OF THRUST			+	+	H	H	H	H	4	3	1	3	4	2	1	3	3	3	4	3
USE PROPELLER SPECIFICATIONS			+	+	L	H	H	H	3	1	3	3	4	2	1	3	3	3	4	3
APPLY THEORY OF BALANCE			+	+	L	H	H	L	3	3	3	3	3	2	3	3	3	3	3	3
IDENTIFY SPECIAL PROPELLER LUBRICANTS			+	+	H	L	H	H	1	4	1	3	2	3	1	3	3	3	3	3

TABLE 27

PROPELLER (GENERAL)

OVERVIEW OF WORK PERFORMED

Propellers require inspection and maintenance, and these tasks are performed by the mechanic in accordance with manufacturer's and FAA specifications. Mechanics perform removal, installation, and tracking, and must understand operating instructions and procedures. In many situations the mechanic must use special tools to accomplish his job on a propeller assembly.

PRINCIPAL FINDINGS

N - Less than 2 percent of the airline mechanics perform general propeller work, with the exception of airline line mechanics working to inspect, track and use a universal protractor.

F - An understanding of the theory of thrust and skill in the use of a propeller protractor is frequently required of mechanics, regardless of industrial category.

M - Airline line mechanics accomplish most of the tasks identified in this table under critical time limitations.

I - Although industry training is primarily to the basic or general information level, airline overhaul stations and large general aviation companies provide in-depth training in selected subtopics.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum.

TABLE 28. FIXED PITCH PROPELLERS (WOOD)

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
REMOVE AND INSTALL			+	+			L	L			3	3			3	3			3	3
REFINISH PROPELLER			$	+			L	L			1	3			3	3			3	3
BALANCE VERTICAL AND HORIZONTAL			-	+			L	L			3	3			3	3			3	3

TABLE 29. FIXED PITCH PROPELLERS (METAL)

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
REPAIR PROPELLER (MINOR)			+	+		H	H	H		3	3	3		3	3	3		2	3	3
REMOVE AND INSTALL			+	+			H	H			3	3			3	3			3	3
REFINISH PROPELLER			$	+			H	H			3	3			3	2			3	3
BALANCE VERTICAL AND HORIZONTAL			$	+		H	L	H		3	3	3		3	3	3		2	3	3

TABLE 28

FIXED PITCH PROPELLERS (WOOD)

TABLE 29

FIXED PITCH PROPELLERS (METAL)

OVERVIEW OF WORK PERFORMED

Mechanics remove, inspect, balance, refinish and install metal and wood fixed pitch propellers. Minor repairs to metal fixed pitch propellers are also performed by mechanics.

PRINCIPAL FINDINGS

N - Less than 2 percent of airline mechanics work on metal propellers and none works on wooden propellers.

F - General aviation mechanics perform work on fixed pitch wood propellers at a low frequency rate, while they work on fixed pitch metal propellers at a high rate of frequency. Airline overhaul mechanics frequently balance and accomplish minor repairs to fixed pitch metal propellers.

T - The technical knowledge required of the mechanic accomplishing these tasks is primarily at the application level.

I - Airline line mechanics receive no training in the subtopics identified.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum.

TABLE 30. GROUND ADJUSTABLE PROPELLERS

	N A O L S	F A O L S	T A O L S	M A O L S	I A O L S
REMOVE AND INSTALL	+ +	H L	3 3	3 3	3 3
DISASSEMBLE AND ASSEMBLE PER MANUFACTURER'S SPECIFICATIONS	$ +	L L	3 3	3 3	3 3
REPAIR BLADES AND HUB (MINOR)	$ +	H H	3 3	3 3	3 3
REPITCH PROPELLER	$ +	L L	3 3	3 3	3 3
BALANCE	- +	L L	3 3	3 3	3 3

TABLE 30

GROUND ADJUSTABLE PROPELLERS

OVERVIEW OF WORK PERFORMED

Currently there are no ground adjustable propellers being manufactured. The ground adjustable propeller is still in existence in general aviation, but in decreasing numbers since 1931. The aviation mechanic may be expected to perform the associated tasks of maintaining and servicing this type of propeller.

PRINCIPAL FINDINGS

N - No airline mechanics perform work on ground adjustable propellers. Only in small general aviation do more than 10 percent of the mechanics work to perform the tasks identified by all the subtopics.

F - This type of propeller is not found in the airline industry and the frequency at which general aviation mechanics work on this propeller is generally low.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

Training in ground adjustable propellers has been recommended for deletion from the aviation mechanics core curriculum because of the continued decrease in the use of this type of propeller. Equivalent manipulative skills and technical knowledge can be gained by the student during his training on other types of propellers.

TABLE 31. TWO POSITION AND CONSTANT SPEED PROPELLERS

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
APPLY THEORY OF OPERATION			+	+			H	L			3	3			1	3			3	3
REMOVE AND INSTALL			+	+			H	H			3	3			3	3			3	3
CHECK OPERATION			+	+			H	H			3	3			3	3			3	3
DISASSEMBLE AND ASSEMBLE PER MANUFACTURER'S SPECIFICATIONS			$	+			H	L			3	3			3	3			3	3
BALANCE PROPELLER			-	+			L	L			3	3			3	3			3	3
OVERHAUL PROPELLER			-	$			L	L			3	3			3	3			4	3

TABLE 31

TWO POSITION AND CONSTANT SPEED PROPELLERS

OVERVIEW OF PROPELLER OPERATION AND WORK PERFORMED

Two position propellers operate in either a low pitch position or a high pitch position. Generally, the low pitch position is used during take-off conditions and the high pitch position is used for cruise or maximum speed conditions. Constant speed propellers are manually controlled to maintain a particular desired engine speed.

Mechanics working on these types of propellers are required to perform tasks in accordance with manufacturer's or FAA specifications for removal, installation, checking operation, disassembly, and assembly. Overhaul and balancing of these propellers is usually performed by specialized propeller shops or repair stations employing the required tools and equipment.

PRINCIPAL FINDINGS

N - Only general aviation mechanics indicated that they worked on two position and constant speed propellers.

F - General aviation mechanics frequently remove, install, and check operation, but the frequency rate for balancing and overhauling this type of propeller is low.

I - Large general aviation companies that overhaul this type of propeller indicate that they provide in-depth training for this task.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

With the exception of propeller balancing and overhaul, all other subtopics should be included in the aviation mechanics core curriculum. These two subtopics were recommended for deletion because of the low frequency with which these jobs are being performed by mechanics. The committee observed that this work is being done by specialty shops.

TABLE 32. CONSTANT SPEED FEATHERING PROPELLERS

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
APPLY THEORY OF OPERATION			+	+	H	H	H	L	3	3	3	3	2	3	1	3	3	4	4	1
REMOVE AND INSTALL			+	+	H	H	H	H	1	3	3	3	2	3	3	3	3	3	3	3
CHECK OPERATION			+	+	H	H	H	H	1	3	3	3	2	3	3	3	3	4	3	3
DISASSEMBLE AND ASSEMBLE PER MANUFACTURER'S SPECIFICATIONS			$	+	H	H	H	H	3	3	3	3	2	3	3	3	3	4	3	3
BALANCE PROPELLER			$	+		H	H	H		3	3	3		3	3	3		4	3	3
OVERHAUL PROPELLER			-	$	H	H	H	L	3	3	3	3	3	3	3	3	3	4	4	3

TABLE 32

CONSTANT SPEED FEATHERING PROPELLERS

OVERVIEW OF PROPELLER OPERATION AND WORK PERFORMED

This type of propeller, in addition to maintaining a selected constant engine speed by varying its blade angle (pitch), has the capability of being fully feathered. Full feathering is used during an engine shut-down on multi-engined aircraft to minimize drag of the shut-down engine and propeller.

Mechanics working on this type of propeller must be familiar with and able to comply with instructions and specifications supplied by the manufacturer or the FAA. The tasks associated with constant speed feathering propellers include removal, installation, checking or operation, disassembly, and assembly. Balancing and overhaul of this type propeller is accomplished in specialized shops.

PRINCIPAL FINDINGS

N - The number of airline mechanics involved in maintaining constant speed feathering propellers is less than 2 percent.

F - Mechanics in all industrial categories report that they work on this type of propeller at a high rate of frequency.

I - Industry training provided by airline overhaul stations is at the in-depth training level.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

With the exception of balancing and overhauling this type of propeller, all other subtopics should be included in the aviation mechanics core curriculum. The committee recommended deleting these subtopics because of the specialization of the tasks, and because specialized shops doing this type of work generally provide industry training for their employees.

TABLE 33. REVERSIBLE PROPELLERS (RECIPROCATING ENGINES)

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
APPLY THEORY OF OPERATION	-		+	$	H	H	H	L	3	4	1	3	2	3	1	3	3	4	4	1
REMOVE AND INSTALL	-		+	$	L	H	H	L	2	3	2	3	5	3	3	3	3	4	4	3
DISASSEMBLE AND ASSEMBLE PER MANUFACTURER'S SPECIFICATIONS	-		-	-	L	H	L	L	3	1	3	3	5	3	3	3	3	4	4	1
OVERHAUL PROPELLER				-	L	H	L	L	4	1	4	3	4	3	4	3	4	4	4	1

TABLE 33

REVERSIBLE PROPELLERS (RECIPROCATING ENGINES)

OVERVIEW OF PROPELLER OPERATION AND WORK PERFORMED

This type of propeller, in addition to being fully featherable, incorporates the added feature of being able to be positioned into a reverse pitch condition. The reverse pitch position is used during the landing roll to aid in decreasing the forward speed of the aircraft. Reciprocating engines tend to overheat during propeller reverse pitch operation and are, therefore, timewise limited during this mode of operation.

Mechanics performing service or maintenance on reversible pitch propellers must be able to remove, install, check operation, disassemble, and assemble them in accordance with manufacturer's and/or FAA specifications. While the balancing and overhaul of these propellers are done in airline propeller shops or certificated propeller repair stations, mechanics are required to diagnose propeller malfunctions and make proper repairs.

PRINCIPAL FINDINGS

N - Less than 2 percent of the mechanics employed by the airline overhaul stations perform these tasks. Fewer than 10 percent of the mechanics employed by small general aviation companies work on reversible propellers.

F - The very limited number of airline overhaul mechanics who do this work report that they work at a high rate of frequency, while the airline line mechanic works at a low rate of frequency.

M - Mechanics employed at airline line stations indicate that time is critical and job planning is required when they are removing, installing, disassembling, or assembling these propellers.

I - In-depth industry training is provided to those mechanics employed at airline overhaul stations and by large general aviation companies.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics, except "Overhaul propeller," should be included in the aviation mechanics core curriculum. The committee recommended deleting this subtopic due to specialization of the task and the training provided by industry.

TABLE 34. REVERSIBLE PROPELLERS (TURBINE ENGINES)

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
APPLY THEORY OF OPERATION			$	$	H	H	H	L	3	3	3	3	2	2	3	3	3	4	4	1
REMOVE AND INSTALL	-		$	-	H	H	H	L	1	4	3	3	2	3	3	3	3	4	4	3
DISASSEMBLE AND ASSEMBLE PER MANUFACTURER'S SPECIFICATIONS			-	-	H	H	H	H	3	3	4	3	2	3	3	3	3	4	4	3
OVERHAUL PROPELLER				-	L	H	L	L	5	1	4	3	4	3	4	3	4	4	4	1
CHECK AND SERVICE TURBOPROP ENGINE BRAKE			-		L	H	L	L	2	3	1	3	4	3	3	3	3	4	4	4

TABLE 34

REVERSIBLE PROPELLERS (TURBINE ENGINES)

OVERVIEW OF PROPELLER OPERATION AND WORK PERFORMED

This type of propeller may also be fully feathered and can be placed in a reverse pitch position to assist in decelerating the aircraft. The turbine engine does not rely upon propeller air blast for cooling; therefore, reverse pitch can be utilized for greater periods of time and may even be used to back the aircraft away from a terminal or dock. These propellers are generally coupled to the engine by a clutch mechanism and incorporate a brake so that the propeller may be both uncoupled from the engine during an engine shut-down and braked to a stop to prevent wind-milling, or free rotation.

Mechanics performing service or maintenance on this type of propeller must be able to remove, install, check operation, disassemble, and assemble them in accordance with manufacturer's and/or FAA specifications. Balancing and overhauling of this propeller assembly is accomplished in airline propeller shops or certificated propeller repair stations; however, the mechanic is required to diagnose propeller problems.

PRINCIPAL FINDINGS

N - Less than 10 percent of the mechanics in any industry category perform these tasks. Less than 2 percent of the airline overhaul mechanics work on this type of propeller.

F - Relatively few mechanics in any category indicate that they work at a high rate of frequency, with the exception of small general aviation, whose mechanics generally perform these tasks at a low rate of frequency.

I - In-depth industry training is provided to the airline overhaul mechanics and mechanics employed by the large general aviation companies.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

Except for the subtopics titled "Overhaul propeller" and "Check and service turboprop engine brake," all subtopics should be included in the aviation mechanics core curriculum. The identified subtopics were recommended for deletion on the basis of task specialization and training provided by industry.

TABLE 35. GOVERNORS

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
LINE INSPECTION AND ADJUSTMENTS	$		+	+	H	H	H	H	3	4	3	3	3	4	3	3	3	4	3	3
APPLY THEORY OF OPERATION	-		+	+	H	H	H	H	3	4	3	3	3	3	3	3	3	4	4	3
SERVICE SYNCHRONIZATION SYSTEM	-		+	+	H	H	H	H	3	4	3	3	3	3	3	3	4	4	3	3
DISASSEMBLE AND ASSEMBLE PER MANUFACTURER'S SPECIFICATIONS			-	+		H	H	L		3	3	3		2	3	3		3	3	3
CHECK AND SERVICE BLEED VALVE GOVERNOR	$		$	$	H	H	H	H	1	4	3	3	3	3	3	3	3	4	4	1
BENCH TEST			-	$		H	H	H		3	4	3		3	3	3		3	3	3
OVERHAUL GOVERNOR			-	$		H	H	L		3	3	3		2	3	3		3	4	3

TABLE 35

GOVERNORS

OVERVIEW OF GOVERNORS AND WORK PERFORMED

Basically, governors are speed-sensing devices used in aircraft turbine and reciprocating engines. In turbine engines, governors prevent "over-speeding" of an engine during acceleration and "under-speeding" of the engine during deceleration; also a governor is used in some engines to bleed air from the compressor at a particular engine speed during acceleration in order to skirt a compressor "stall" zone. In reciprocating engines, governors are used to maintain a constant engine speed by increasing or decreasing the pitch of the propeller.

On reciprocating engines, mechanics make limited field adjustments on governors; however, on turbine engines the governors are pre-set by bench testing and are usually not field adjustable. Overhaul or repair shops have the proper test equipment to perform this specialized service. Mechanics perform checks and troubleshoot governor operation, remove, install, and properly rig governors where necessary.

PRINCIPAL FINDINGS

N - Less than 10 percent of the airline mechanics perform the tasks associated with governors.

F - Mechanics in all industrial categories generally work with governors at a high frequency; however, airline line station mechanics do not disassemble, assemble, bench test, or overhaul governors.

T - The technical knowledge required by airline overhaul stations is primarily at the analysis level, and large general aviation companies have the same requirement for mechanics who bench test governors.

M - The manipulative skill generally needed by mechanics performing these tasks allows reasonable time, but job planning is required.

I - Airline overhaul stations and large general aviation companies provide training in depth in many of the subtopics.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

The committee recommended deleting the subtopic identified as "Overhaul governor." All other subtopics should be included in the aviation mechanics core curriculum. The recommendation for deletion of the subtopic was based on the very limited number of mechanics who perform this task and the highly specialized equipment required to accomplish this training.

TABLE 36. DRAFTING

	N A	N O	N L	N S	F A	F O	F L	F S	T A	T O	T L	T S	M A	M O	M L	M S	I A	I O	I L	I S
USE AND INTERPRET STANDARD BLUEPRINT INFORMATION	+	+	+	+	H	H	H	H	2	3	3	3	2	3	1	3	3	4	1	1
CARE OF BLUEPRINTS	+	+	+	+	H	H	H	H	3	3	1	3	2	3	1	3	3	3	1	1
INTERPRET AND APPLY DATA IN TITLE BLOCK, BILL OF MATERIALS, ETC.	+		+	+	H	H	H	L	2	4	2	3	2	3	1	3	3	1	1	3
DRAW SHOP SKETCHES	$	-	+	+	H	H	H	H	2	3	3	3	2	3	3	3	3	3	3	1
USE APPROPRIATE SYMBOLS I.E., HYDRAULIC, ELECTRICAL, ETC.			+	+	H	H	H	H	3	1	3	3	4	2	3	2	1	3	3	2
USE AND CARE OF ESSENTIAL DRAFTING INSTRUMENTS AND EQUIPMENT			$	+	L	H	H	L	2	3	3	3	4	3	2	3	1	1	3	3
DRAW PROJECTIONS			$	+	H	H	H	L	3	3	3	3	3	3	3	3	1	3	3	1
USE OF SPECIFICATIONS AND DRAFTING ROOM MANUALS			$	+	H	H	H	L	3	3	3	3	3	2	3	3	2	4	3	1
DRAW INTERSECTIONS AND DEVELOPMENTS			$	+	H	H	H	L	3	3	3	3	3	3	3	3	1	3	3	3
DRAW LINES, DIMENSIONS, SECTIONS, SCALES, ETC.			$	+	H	H	H	L	3	3	3	3	3	2	2	3	1	3	3	3
DRAW TECHNICAL WORKING DRAWINGS			$	+	H	H	H	L	3	3	3	3	5	3	3	3	4	1	3	1

TABLE 36

DRAFTING

OVERVIEW OF WORK PERFORMED

Mechanics frequently work with blueprints and drawings when making installations and modification to the structure and systems of the airplane. They must be able to read and interpret data from schematics when analyzing system malfunctions and incorporate changes in drawings in accordance with standard drafting procedures. In addition, they often sketch small parts and develop shop drawings for replacement parts and repairs.

PRINCIPAL FINDINGS

N - There is evidence that mechanics in all industrial categories must be able to interpret standard blueprint information, be capable of caring for the blueprints, and have some skill in drawing shop sketches. Less than 2 percent of the airline mechanics actually draw projections or do similar formal drafting work.

F - Mechanics employed by small general aviation companies indicate that they infrequently use drafting equipment, draw projections, or prepare working drawings.

I - The relatively few airline mechanics who prepare drawings receive in-depth industry training.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

Based upon the findings, the committee recommended deleting the following subtopics:

1) Use of specification and drafting room manuals
2) Draw intersections and developments
3) Draw lines, dimensions, sections, scales, etc.
4) Draw technical working drawings

All other subtopics should be included in the aviation mechanics core curriculum.

TABLE 37. WEIGHT AND BALANCE

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
USE SPECIFICATIONS, DATA SHEETS, AND AIRCRAFT LISTING			+	+	L	L	H	H	1	4	3	3	4	4	3	3	3	2	3	3
PREPARE AND WEIGH AIRCRAFT			+	+	L	L	H	L	1	4	3	3	4	4	3	3	3	2	3	3
MEASURE MOMENT ARM			+	+	H	L	H	H	3	4	3	3	3	4	3	3	1	2	3	3
COMPUTE WEIGHT AND BALANCE			+	+	H	L	H	H	3	4	3	3	3	4	3	3	3	2	3	3
CORRECT FOR ADVERSE CONDITIONS OR EFFECTS OF IMPROPER LOADING			+	+	H	L	H	L	4	4	3	3	5	4	3	3	4	2	3	3
RECORD WEIGHT AND BALANCE DATA			+	+	L	L	H	H	1	4	3	3	4	4	3	3	3	2	3	3
USE TERMINOLOGY AND SYMBOLS			+	+	L	L	H	H	1	4	3	3	4	4	3	3	2	2	3	1
USE LOADING GRAPHS, CENTER OF GRAVITY ENVELOPES AND LOADING SCHEDULES			+	+	H	H	H	H	4	4	3	3	3	4	3	3	4	4	3	3
USE OF FAA 337 FORM AND CAM 18			+	+	L	H	H	H	3	4	3	3	3	4	3	3	2	1	3	3

TABLE 37

WEIGHT AND BALANCE

OVERVIEW OF WORK PERFORMED

Flight characteristics are significantly dependent upon an aircraft's weight and balance. The weight and balance of an aircraft is affected by the location and weight of installed equipment. Changes in weight and location of equipment affect (aircraft) balance. When the mechanic actually installs equipment or changes its location, he must know how to compute weight and balance and maintain the center of gravity within the manufacturer's specifications. Airplanes are weighed, and the center of gravity may be computed many times during the life of an airplane.

PRINCIPAL FINDINGS

N - Less than 2 percent of the mechanics employed by the airlines and more than 10 percent of the mechanics employed in general aviation perform weight and balance calculations.

F - General aviation mechanics perform weight and balance computation at a generally high level of frequency.

T - Technical knowledge required ranges from the knowledge level for airline line mechanics through the analysis level for airline overhaul mechanics.

I - The airlines offer in-depth training in the subtopics titled "Correct for adverse conditions or effects of improper loading" and "Use loading graphs, center of gravity envelopes, and loading schedules."

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

The committee recommended deleting the following subtopics:

1) Use loading graphs, center of gravity envelopes and loading schedules. Deletion recommended on the basis of task specialization and industry training offered.

2) Use of FAA 337 form and CAM 18. Deletion recommended on the basis of non-applicability.

All other subtopics identified by this table should be included in the aviation mechanics core curriculum.

TABLE 38. AIRCRAFT MATERIAL AND PROCESSES

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
IDENTIFY STANDARD HARDWARE AND MATERIALS	+	+	+	+	H	H	H	H	3	3	2	3	2	3	1	3	3	3	3	3
USE THE TECHNICAL TERMINOLOGY COMMON TO MATERIALS UTILIZED IN AIRFRAMES AND PROPULSION UNITS	$	+	+	+	H	H	H	H	3	3	2	3	1	3	1	3	3	4	4	1
DEVELOP AN UNDERSTANDING OF STRUCTURE AND COMPOSITION OF METALS AND THEIR ALLOYS SUCH AS SAE STEELS, CORROSION RESISTANT STEEL, COPPER, NICKEL, ALUMINUM, MAGNESIUM, TITANIUM, SPECIAL HIGH TEMPERATURE METALS, ETC.	$	+	+	+	H	H	H	H	3	3	3	3	3	3	1	3	3	4	3	1
IDENTIFY TYPES OF CORROSION AND PREVENTIVE MEASURES	$	+	+	+	H	H	H	H	3	3	3	3	3	3	3	3	3	4	3	3
IDENTIFY PIPING COLOR CODING	$	+	+	+	H	H	H	H	1	3	3	3	1	3	1	2	2	3	2	3
PERFORM BASIC HEAT TREATING AND ANNEALING PROCESSES	-	+	$	+	H	H	H	H	2	3	3	3	2	3	3	3	3	3	4	1
IDENTIFY PHYSICAL PROPERTIES OF MATERIALS	-	$	+	+	H	H	H	H	3	3	3	3	3	3	1	3	3	3	3	1
IDENTIFY MECHANICAL PROPERTIES OF MATERIALS	-	$	+	+	H	H	H	H	3	3	3	3	3	3	1	3	3	3	3	1
APPLY PRINCIPLES OF ADHESIVE BONDING	$	-	+	+	H	H	H	H	3	3	3	3	3	3	3	3	3	3	3	3
UTILIZE BASIC ECONOMIC AND ENGINEERING CRITERIA IN SELECTION OF MATERIALS	-		+	+	H	H	H	H	2	2	3	3	2	2	3	3	2	4	3	1
IDENTIFY WINDSHIELD AND WINDOW MATERIALS	-		+	+	H	H	H	H	1	3	3	3	2	3	3	3	3	3	3	3
USE HIGH ENERGY FORMING PROCESSES				-	H		H	H	3		3	3	3		3	3	3		4	3

TABLE 38

AIRCRAFT MATERIAL AND PROCESSES

OVERVIEW OF WORK PERFORMED

A mechanic's ability to properly inspect, repair, and maintain an airplane often depends upon his understanding of the basic processes and materials employed in its construction. Knowledge of the various materials, technical terminology, and the ability to identify standard hardware is essential to the aviation mechanic.

PRINCIPAL FINDINGS

F - Mechanics in all industrial categories indicated a high frequency for these tasks.

I - Airline overhaul mechanics receive in-depth training in the use of technical terminology, structure and composition of metals, and the identification and prevention of corrosion. Mechanics employed by large general aviation companies indicate that they are trained in the use of technical terminology, basic heat-treating and annealing processes, and the use of high energy forming processes.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

The committee recommended that all subtopics be included in the aviation mechanics core curriculum. The committee observed that many of these tasks and understandings are basic and therefore necessary to the mechanic's overall knowledge of the airplane and its systems.

TABLE 39. INSPECTION FUNDAMENTALS

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
INSPECT FOR GENERAL SOURCE OF WEAR AND DETERIORATION	+	+	+	+	H	H	H	H	3	3	3	3	3	3	1	3	3	3	3	3
COMPLETE TYPICAL REPORT FORMS AND STATUS TAGS	+	+	+	+	H	H	H	H	1	3	3	3	1	3	1	2	2	3	3	1
USE PRECISION MEASURING DEVICES—MICROMETERS, HEIGHT GAGES, ETC.	+	$	+	+	H	H	H	H	3	3	3	3	3	1	2	3	2	3	2	3
USE MANUFACTURER'S INSPECTION DATA	$		+	+	H	H	H	H	3	1	2	3	3	2	1	3	2	4	2	1
USE NON-DESTRUCTIVE TESTING																				
PENETRANTS	-	-	+	+	H	H	H	H	3	3	3	3	3	3	3	3	3	3	3	3
USE FUNDAMENTALS OF STATISTICAL INSPECTION	-		+	+	H	H	H	H	3	3	3	3	3	2	1	3	3	3	3	1
USE NON-DESTRUCTIVE TESTING																				
MAGNETIC PARTICLE	-		+	+	H	H	H	H	3	3	3	3	3	2	3	3	3	3	3	3
CHEMICAL ETCHING			$	+	H	H	H	L	4	3	3	3	3	2	3	3	3	3	3	3
HARDNESS	-		$	$	H	H	H	L	3	3	3	3	3	2	2	3	3	4	2	3
USE DESTRUCTIVE TESTING																				
TENSION			-	-			H	H			3	3			3	3			3	3
BENDING			-	-			H	H			3	3			3	3			3	3
IMPACT			-				H	H			3	3			2	3			3	3
USE NON-DESTRUCTIVE TESTING																				
ULTRA SONIC			-		H	H	H	H	3	3	2	3	3	3	3	3	3	4	2	3
RADIOGRAPHY (X RAY)					H	H	H	H	3	4	3	3	3	4	3	3	3	3	2	1

TABLE 39

INSPECTION FUNDAMENTALS

OVERVIEW OF WORK PERFORMED

Mechanics inspect both materials and components to determine condition, wear, material strength, and fatigue. Many inspection techniques and devices are used, such as micrometers, gauges, and X ray. Non-destructive methods are used in the inspection and maintenance of airplanes and their components, while destructive testing is most generally used during the manufacturing process.

PRINCIPAL FINDINGS

N - Less than 5 percent of the mechanics use destructive testing as a means of inspection and none perform this task in the airline industry.

F - Most of the subtopic tasks are performed at a high rate of frequency by mechanics in all categories.

I - Airline overhaul mechanics indicate that they receive in-depth training in the use of manufacturer's inspection data, hardness testing, and the techniques of ultrasonic inspection.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

The committee recommended deleting the subtopic, "Use destructive testing: tension, bending, and impact." They further recommended that the use of eddy current non-destructive testing be included in the aviation mechanics core curriculum. This subtopic has been added to the core curriculum and is listed on page 191.

TABLE 40. AIRCRAFT AND ENGINE INSPECTION

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
PERFORM AND RECORD INSPECTIONS PER MANUFACTURER'S FAA OR PROGRESSIVE REQUIREMENTS	+	-	+	+	H	H	H	H	3	3	3	3	3	2	3	3	3	4	3	3
INSPECT AIRCRAFT (WALK AROUND)	+	-	+	+	H	H	H	H	3	2	3	3	3	4	1	3	3	3	3	3
USE INSPECTION GUIDES	+	-	+	+	H	H	H	H	3	2	3	3	3	1	1	3	3	2	1	3
INSPECT AIRCRAFT (ANNUAL)	+		+	+	H	H	H	H	3	3	3	3	3	4	1	3	3	3	3	3
USE MANUFACTURER'S SERVICE BULLETINS	$	$	+	+	H	H	H	H	3	3	3	3	3	1	1	3	3	2	3	3
INSPECT AIRCRAFT (OVERHAUL CHECKS)	$		+	+	H	H	H	H	3	4	3	3	3	5	1	3	3	4	3	3
USE GENERAL AVIATION INSPECTION AIDS SUMMARY	-		+	+	H		H	H	3		3	3	3		1	3	4		1	3
CHECK STORAGE STATUS OF NON-ACTIVE AIRCRAFT			+	+	H	H	H	H	3	1	3	3	3	1	3	3	4	2	3	3

TABLE 40

AIRCRAFT AND ENGINE INSPECTION

OVERVIEW OF WORK PERFORMED

Aircraft and engine inspections may range from pre-flight checks to the detailed inspection following a major overhaul. Mechanics must know how to determine the condition of the aircraft and powerplant, how to use inspection guides, and how to properly record the inspection on the required forms.

PRINCIPAL FINDINGS

N - More than 10 percent of the mechanics in general aviation perform aircraft and engine inspections.

F - All mechanics perform inspections at a high frequency.

T - The technical knowledge required by airline overhaul mechanics is at the analysis level when they are accomplishing aircraft overhaul checks.

M - Airline overhaul mechanics indicate that time is critical and that they must do job planning as they perform "walk around" and annual inspections and inspect the aircraft during overhaul checks.

I - The airlines provide training in-depth for several of the subtopics, while general aviation training is primarily basic or informational.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

The committee recommended that "Checking the storage status of nonactive aircraft" be deleted from the curriculum. All other subtopics should be included in the aviation mechanics core curriculum.

TABLE 41. GROUND SUPPORT EQUIPMENT

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
USE HYDRAULIC EQUIPMENT	+	-	+	+	H	H	H	H	2	3	2	3	3	5	2	3	3	4	2	3
USE PNEUMATIC EQUIPMENT	+	-	+	+	H	H	H	H	2	3	2	3	3	5	2	3	3	3	2	3
USE ELECTRICAL EQUIPMENT	+	-	+	+	H	H	H	H	2	3	3	3	3	5	2	3	3	4	2	3
USE FUELS, LUBRICANTS AND FLUIDS	+	-	+	+	H	H	H	H	2	3	2	3	3	5	2	3	3	4	2	3
USE GROUND FIRE PROTECTION	+	-	+	+	H	H	H	H	2	3	3	3	3	4	2	3	3	4	2	3
USE LINE STARTING EQUIPMENT	+	-	+	+	H	H	H	H	2	3	2	3	3	3	2	3	3	4	2	1
DRIVE FUEL TRUCKS	$		+	+	H	H	H	H	2	4	3	3	3	4	3	2	3	4	3	3
USE GROUND AIR CONDITIONER	$		+	$	H		H	H	2		3	3	3		2	3	2		3	3

TABLE 41

GROUND SUPPORT EQUIPMENT

OVERVIEW OF WORK PERFORMED

Mechanics operate and supervise the use of ground power units, air conditioners, and fueling and fire protection equipment. They must also know how to service and maintain such equipment.

PRINCIPAL FINDINGS

N - Less than 5 percent of the airline overhaul mechanics accomplish the tasks identified in this table.

F - Mechanics in all industrial categories indicated that they performed these tasks frequently.

M - The very few airline overhaul mechanics who use ground support equipment must do job planning and accomplish the work under critical time limitations.

I - Airline overhaul stations provide training in depth as a specialty, rather than the general knowledge approach in the other industrial categories.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

The committee recommended that the ability and the associated knowledge required to drive fuel trucks and operate ground air conditioners are not to be included in the aviation mechanics core curriculum; therefore, the subtopics "Drive fuel trucks" and "Use ground air conditioner" have been deleted from the core curriculum. All other subtopics are included.

TABLE 42. GROUND HANDLING

	N				F				T				M				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
USE STANDARD LINE AND TAXI SIGNALS	+	−	+	+	H	H	H	H	2	3	2	3	2	4	5	1	3	4	4	1
USE TOW BARS AND TOWING EQUIPMENT	+	−	+	+	H	H	H	H	2	3	3	3	3	1	2	3	3	4	3	1
JACK AIRCRAFT	+	−	+	+	H	H	H	H	3	3	3	3	3	1	3	3	3	4	3	3
SPOT AND MOOR AIRCRAFT	$	−	+	+	H	H	H	H	4	3	3	3	3	1	3	3	3	4	3	1
FUEL AIRCRAFT	$	−	+	+	H	H	H	H	2	3	3	3	2	5	3	2	4	4	3	1
PERFORM PRE-FLIGHT SERVICING	$	−	+	+	H	H	H	H	3	3	3	3	3	5	2	2	3	4	2	3
PERFORM POST-FLIGHT SERVICING	$	−	+	+	H	H	H	H	3	3	3	3	3	5	2	2	3	4	2	3
TAXI AIRCRAFT	−	−	+	+	H	H	H	H	3	3	3	3	3	1	3	3	4	4	3	1
HOIST AIRCRAFT			+	+	H	H	H	H	4	4	3	3	5	4	3	3	3	4	3	3

TABLE 42

GROUND HANDLING

OVERVIEW OF WORK PERFORMED

Mechanics taxi, tow, and position airplanes on the ground. They also direct aircraft on the ground through the use of hand signals. Mechanics must know how to jack and hoist the aircraft, as well as secure it for adverse weather conditions.

PRINCIPAL FINDINGS

N - Less than 5 percent of airline overhaul mechanics perform the tasks identified in this table.

F - Mechanics in all of the industrial categories indicated that they perform ground handling jobs frequently.

T - Airline mechanics indicate that their knowledge of methods of hoisting an airplane is at the analysis level.

M - Airline mechanics hoist aircraft under time critical conditions.

I - The limited number of airline overhaul mechanics who do this work are trained in depth in all of the subtopics. Mechanics at airline line stations receive in-depth training in fueling and taxiing aircraft.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

The committee recommended deleting the subtopic titled "Hoist aircraft" because this is a specialized task occurring infrequently and utilizing special equipment. All other subtopics should be included in the aviation mechanics core curriculum.

TABLE 43. CLEANING AND CORROSION CONTROL

	N A	N O	N L	N S	F A	F O	F L	F S	T A	T O	T L	T S	M A	M O	M L	M S	I A	I O	I L	I S
IDENTIFY APPLICATIONS AND LIMITATIONS OF																				
CHEMICAL SOLVENTS AND PAINT REMOVERS	-	+	+	+	H	H	H	H	4	3	3	3	3	3	2	3	3	3	3	3
USE CLEANING EQUIPMENT AND PROCEDURES FOR																				
VAPOR DEGREASING	$	-	+	+	H	H	H	H	2	3	3	3	3	3	3	3	3	3	3	3
INSPECT FOR EVIDENCE OF CORROSION IN CRITICAL AREAS	$	-	+	+	H	H	H	H	3	3	3	3	3	3	2	3	3	3	3	3
IDENTIFY APPLICATIONS AND LIMITATIONS OF																				
SOAPS AND DETERGENTS	$		+	+	H	H	H	H	4	1	2	3	3	2	2	2	3	3	3	3
WINDOW AND WINDSHIELD CLEANING AGENTS	$		+	+	H	H	H	H	1	3	2	3	2	3	2	3	3	3	3	3
INSPECT AND DETERMINE ADEQUACY OF CLEANING PERFORMED ON AIRPLANES	$		+	+	H	H	H	H	3	3	3	3	3	3	2	2	3	3	3	1
APPLY PRINCIPLES OF AIRPLANE CLEANING AND CORROSION CONTROL	-	-	+	+	H	H	H	H	4	1	3	3	3	2	2	3	3	3	1	3
USE INTERIOR CLEANING EQUIPMENT AND PROCEDURES	-		+	+	H	H	H	H	3	1	2	3	5	2	2	3	3	3	1	3
USE CARBON REMOVERS	-		+	+	H	H	H	H	3	1	3	3	3	2	2	3	2	3	3	3
USE SAND, SHELL, GRIT, AND VAPOR BLASTING			+	+	H	H	H	H	3	3	3	3	3	1	2	3	3	3	1	3
USE CLEANING EQUIPMENT AND PROCEDURES FOR																				
ELECTRICAL COMPONENT CLEANING	-		$	+	H	H	H	H	3	4	3	3	3	4	3	3	3	2	3	3
ULTRASONIC DEGREASING			-	-	H	H	H	H	3	3	3	3	3	1	3	3	3	3	2	1

TABLE 43

CLEANING AND CORROSION CONTROL

OVERVIEW OF WORK PERFORMED

Mechanics clean the airplane, both inside and out, to prevent and control corrosion. The improper use of a solvent or cleaning agent can do more damage than the material that was removed. Improper neutralization of spilled battery acid and other chemicals can cause severe structural damage. A thorough cleaning is necessary in order to properly inspect an aircraft.

PRINCIPAL FINDINGS

F - Mechanics in all industrial categories perform cleaning and corrosion control frequently.

T - Airline line mechanics require analysis levels of technical knowledge for subtopics pertaining to cleaning and corrosion control.

M - Airline line mechanics work under critical time conditions when cleaning the interiors of airplanes.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

The committee recommended that the subtopic "Identify the applications and limitations of chemical solvents and paint removers" include information relative to the flammability and explosive characteristics of these materials; therefore, this subtopic has been expanded to include flammability and explosive characteristics of these materials. All subtopics should be included in the aviation mechanics core curriculum.

TABLE 44. MATHEMATICS

	N				F				T				A/S				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
ADD, SUBTRACT, MULTIPLY AND DIVIDE	+	+	+	+	H	H	H	H	3	3	3	3	1	1	1	1	3	1	1	1
READ AND INTERPRET GRAPHS AND CHARTS	+	-	+	+	H	H	H	H	3	3	3	3	1	1	1	1	1	3	4	1
CALCULATE RATIOS, PROPORTIONS AND PERCENTAGES	+		+	+	H	H	H	H	3	3	3	3	1	1	1	1	1	1	1	1
PERFORM ALGEBRAIC OPERATIONS INVOLVING SUBTRACTION, ADDITION, MULTIPLICATION AND DIVISION OF POSITIVE AND NEGATIVE NUMBERS	$		+	+	H	H	H	H	3	3	3	3	1	1	1	1	1	3	1	1
PERFORM LAYOUTS UTILIZING FUNDAMENTALS OF GEOMETRIC CONSTRUCTION	-		+	+	H	H	H	H	3	3	3	3	1	1	1	1	1	2	1	1
EXTRACT ROOTS AND RAISE NUMBERS TO GIVEN POWERS	$		$	+	H	H	H	H	3	4	3	3	1	1	1	1	1	1	1	1
PERFORM DESCRIPTIVE GEOMETRY AS APPLIED TO TEMPLATE DEVELOPMENT AND LAYOUT	-	-	$	+	H	H	H	L	3	3	3	3	1	1	1	1	1	1	1	1
CALCULATE AREAS AND VOLUMES OF VARIOUS GEOMETRIC SHAPES	-		$	+	H	H	H	H	3	3	3	3	1	1	1	1	1	1	1	1
PERFORM CALCULATIONS COMMON TO RIGHT TRIANGLES AND USE OF TRIGONOMETRIC TABLES	-		$	+	H	H	H	H	3	1	3	3	1	1	1	1	1	1	1	1
PERFORM CALCULATIONS INVOLVING USE OF SLIDE RULE	-		-	+	H	H	H	H	3	2	3	3	1	1	1	1	1	1	1	1

TABLE 44

MATHEMATICS

OVERVIEW OF WORK PERFORMED

Mathematics is a basic requirement for the aviation mechanic, even though requirements will vary with the type of work being performed. The skills may range from basic arithmetic through the algebra required for weight and balance computation to the geometry and trigonometry required for template development and layout. Electrical and electronic circuit analysis may require the use of advanced mathematics. Many formulas are available to the mechanics who require solutions of problems in mathematics.

PRINCIPAL FINDINGS

F - Aviation mechanics in all industrial categories indicate that the use of mathematics is at a high frequency.

A/S- Accuracy of computation is emphasized.

I - Generally, no industry training is provided.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

Performing calculations common to a right triangle and the use of trigonometric tables and performing calculations involving the use of a slide rule are recommended for deletion from the aviation mechanics curriculum. The committee also recommended that the schools test to determine where remedial training is required. All other subtopics should be included in the core curriculum.

TABLE 45. ENGLISH

	N				F				T				A/S				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
READ, WRITE AND SPEAK THE ENGLISH LANGUAGE	+	+	+	+	H	H	H	H	3	2	3	3	2	1	2	1	1	1	1	1
WRITE CLEAR, CONCISE, GRAMMATICALLY CORRECT TECHNICAL REPORTS NORMALLY EXPECTED OF CERTIFICATED MECHANICS	+	+	+	+	H	H	H	H	3	3	2	3	2	1	2	1	1	1	1	1
USE DICTIONARY AND STANDARD REFERENCE BOOKS	+	+	+	+	H	H	H	H	3	3	2	3	1	1	2	1	1	1	1	1
READ PERTINENT TECHNICAL DATA WITH COMPREHENSION	+	+	+	+	H	H	H	H	3	3	2	3	1	1	2	1	1	1	1	1

TABLE 45

ENGLISH

OVERVIEW OF WORK PERFORMED

The ability to speak, read, write, and understand the English language is required of the aviation mechanic. He must communicate with others, and write descriptions of technical work performed when he makes the required entries in the aircraft maintenance records. Reading comprehension is necessary if the mechanic is to understand maintenance manuals and other publications related to servicing, inspection, and repair of the aircraft.

PRINCIPAL FINDINGS

N,F- More than 10 percent of the mechanics in all industrial categories utilize the subtopics at a high rate of frequency during performance of their jobs.

A/S- Mechanics employed by large general aviation companies indicated that both speed and accuracy are required.

I - No industry training is provided.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum. The committee strongly recommended that increased emphasis be placed on the teaching of English and the schools should initiate remedial training as required. The committee repeatedly stressed that the aviation mechanic who is to succeed in the aviation industry must be able to use the English language correctly and that schools should assist in every way to reinforce his ability to use the language.

TABLE 46. PHYSICS

	N				F				T				A/S				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
PERFORM CALCULATIONS INVOLVING MECHANICS SUCH AS LEVERS, PULLEYS, INCLINED PLANES, LINEAR MOTION, ETC.	+	+	+	+	H	H	H	H	3	1	3	3	1	1	1	1	1	1	1	1
SOLVE GAS AND FLUID PROBLEMS SUCH AS PRESSURE, VOLUME, PASCAL'S LAW, BERNOULLI'S PRINCIPLE, ETC.	-		+	+	H	H	H	H	3	3	3	3	1	1	2	1	1	3	4	1
PERFORM TEMPERATURE CONVERSIONS, PROBLEMS INVOLVING RELATIONSHIPS OF GASES AND PRESSURES AND MECHANICAL EQUIVALENTS OF HEAT	-		+	+	H	H	H	L	3	3	3	3	1	1	2	1	1	3	4	1
PERFORM NECESSARY CALCULATIONS TO UNDERSTAND EFFECT OF SPEED OF SOUND, FREQUENCY, PRESSURE, LOUDNESS, REFLECTION OF SOUND WAVES, ETC.			$	$	L	H	H	H	3	3	3	3	1	1	2	1	1	1	4	1

TABLE 46

PHYSICS

OVERVIEW OF WORK PERFORMED

An understanding of the laws of physics helps the mechanic to better understand the aircraft systems with which he must work. With such principles to guide him, he has a better foundation to analyze, troubleshoot, service, and maintain the various aircraft and power-plant systems.

PRINCIPAL FINDINGS

F - Generally, aviation mechanics apply the principles of physics at a high rate of frequency.

I - Mechanics employed by large general aviation companies indicate that they receive in-depth training in a majority of the sub-topics. Otherwise very little industry training is generally offered.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum.

TABLE 47. CHEMISTRY

	N				F				T				A/S				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
APPLY CHEMICAL PRINCIPLES TO																				
ELECTROLYSIS AND ITS EFFECT	$	-	+	+	H	H	H	H	3	3	3	3	1	1	1	1	1	3	1	1
BASIC CHEMISTRY OF FUELS, LUBRICANTS AND HYDRAULIC FLUIDS	-	$	+	+	H	H	H	H	3	3	3	3	1	1	1	1	3	3	3	1
THE BASIC CHEMISTRY OF PAINTS, LACQUERS AND THINNERS	-	-	+	+	H	H	H	H	3	3	3	3	1	1	1	1	1	3	3	1
THE CHEMICAL REACTIONS WITHIN BATTERIES	-		+	+	H	H	H	H	3	3	3	3	1	1	1	1	1	2	3	1
THE CHEMISTRY OF ADHESIVES AND SEALING MATERIALS	-	-	$	+	H	H	H	H	2	3	3	3	1	1	1	1	2	3	3	1
COMMON ELEMENTS AND ELEMENTARY COMPOUNDS SUCH AS SALTS, BASES, AND ACIDS			$	+	H	H	H	H	3	3	3	3	1	1	1	1	1	1	1	1
THE CHEMISTRY OF PLASTICS BOTH CLEAR AND REINFORCED	-		$	$	H	H	H	H	3	3	3	3	1	1	1	1	1	3	3	1
THE COMPOSITION OF MATTER—MOLECULES, ATOMS AND ELECTRONS	-		-	$	H		L	H	3		1	3	1		1	1	1		1	1
THE CHEMISTRY OF NATURAL AND SYNTHETIC FABRICS			-	$			H	L			3	3			1	1			3	1
USE CHEMICAL SYMBOLS AND EQUATIONS	-		-	-	H	H	H	H	3	3	3	3	1	1	1	1	1	1	3	1
USE PERIODIC TABLE				-		H	H	L		3	2	3		1	1	1		2	3	1

TABLE 47

CHEMISTRY

OVERVIEW OF WORK PERFORMED

A mechanic must be aware of certain chemical principles if he is to understand the operation and maintenance of batteries; the process of plating, the prevention of corrosion; and the properties of the various aircraft fluids, fuels, solvents, and paints. Although mechanics do not work with chemical formulas, they do make many practical applications of the principles of chemistry.

PRINCIPAL FINDINGS

N - Less than 10 percent of the airline mechanics indicated that they used the knowledge identified by the subtopics of this table.

F - Generally, mechanics in all industrial categories frequently apply chemical principles in the performance of their job.

A/S- All segments of industry indicate that there is a requirement for accuracy.

I - Very little industry training is given, although the principles of chemistry are included in various orientation, or basic, informational content courses.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

As a result of the findings, the committee recommended deleting the subtopics titled:

1) Apply chemical principles to the chemistry of plastics, both clear and reinforced

2) The composition of matter, molecules, atoms, and electrons

3) The chemistry of natural and synthetic fabrics

4) Use of chemical symbols and equations

5) Use of periodic table

All other subtopics should be included in the core curriculum.

TABLE 48. AIRCRAFT NOMENCLATURE

	N A O L S	F A O L S	T A O L S	A/S A O L S	I A O L S
USE PROPER AIRCRAFT NOMENCLATURE	+ + + +	H H H H	3 2 3 3	1 1 2 1	2 3 3 1
CLASSIFY AIRCRAFT AS TO PROPULSION DEVICES, WING ARRANGEMENT, PURPOSE, LANDING GEAR SYSTEMS, ETC.	+ - + +	H H H H	3 3 3 3	1 1 2 1	3 2 3 1
APPLY FAA AIRCRAFT CATEGORIES AND DEFINITIONS AS FOUND IN APPROPRIATE PUBLICATIONS SUCH AS FAR 1, 21, 23, ETC.	$ - + +	H H H H	3 1 3 3	1 1 2 1	1 3 3 1

TABLE 48

AIRCRAFT NOMENCLATURE

OVERVIEW OF WORK PERFORMED

Aviation mechanics must use proper nomenclature to communicate effectively. Mechanics order parts, prepare malfunction reports, make entries in maintenance records, and comply with service letters and Airworthiness Directives. Correct nomenclature is essential in writing or interpreting technical reports.

PRINCIPAL FINDINGS

F - Mechanics in all industrial categories use technical terms and nomenclature constantly.

I - Industry training ranges from no training to basic, informational content courses.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum.

TABLE 49. THEORY OF FLIGHT

	N				F				T				A/S				I			
	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S	A	O	L	S
INTERPRET THEORY OF FLIGHT IN RELATION TO																				
REFERENCE AXES OF AIRCRAFT	$	$	+	+	H	H	H	H	3	3	3	3	1	1	1	1	1	3	3	1
FUNCTION OF CONVENTIONAL CONTROLS AND CONTROL SURFACES	$	$	+	+	H	H	H	H	4	1	3	3	1	1	1	1	1	3	3	1
HIGH LIFT DEVICES SUCH AS FLAPS, SLATS, ETC.	$	$	+	+	H	H	H	H	3	1	3	3	1	1	1	1	3	3	3	1
PROPERTIES OF THE EARTH'S ATMOSPHERE	$	-	+	+	H	H	H	H	3	3	3	3	1	1	1	1	1	1	1	1
AIRCRAFT MANEUVERS SUCH AS TURNS, SKIDS, STALLS, ETC.	$	-	+	+	H	H	H	H	3	3	3	3	1	1	1	1	1	3	3	1
FORCES ACTING ON AN AIRFOIL AND AIRPLANE	$		+	+	H	H	H	H	3	3	3	3	1	1	1	1	1	2	1	1
UNCONVENTIONAL CONTROLS AND CONTROL SURFACES	$		+	+	H	H	H	H	3	3	3	3	1	1	1	1	3	3	3	1
LOADS AND EFFECT OF TURBULENCE AND SPEED	$		+	+	H	H	H	H	3	3	3	3	1	1	1	1	4	3	3	1
WING LOADING, POWER LOADING, MANEUVERING SPEED, ETC.	-		+	+	H	H	H	H	3	3	3	3	1	1	1	1	2	3	1	1
ROTARY WING	-		$	+	H	H	H	H	3	3	3	3	1	1	2	1	1	1	3	3
ROTORCRAFT FLIGHT CONTROLS AND THEIR EFFECTS	-		$	+	H	H	H	H	3	3	3	3	1	1	2	1	1	1	3	3
THRUST TORQUE AND TORQUE CORRECTION AS APPLIED TO ROTORCRAFT	-		$	+	H	H	H	H	3	3	3	3	1	1	2	1	1	4	4	1

TABLE 49

THEORY OF FLIGHT

OVERVIEW OF WORK PERFORMED

Mechanics must understand the relationships between the atmosphere and the airplane and its forces in flight in order to make intelligent decisions affecting the flight safety of both airplanes and helicopters. Understanding why the airplane is designed with a particular type of primary and secondary control system, and why the surfaces must be aerodynamically smooth become essential knowledge when maintaining today's complex aircraft.

PRINCIPAL FINDINGS

N - Less than 10 percent of the airline mechanics report that they make use of this knowledge.

F - Mechanics in all of the industrial categories indicate that they use theory of flight knowledge at a high rate of frequency.

I - Airline line mechanics indicate that they receive in-depth training in loads and the effect of turbulence and speed. General aviation companies specializing in rotorcraft provide basic or general information training for their mechanics, but training by fixed wing operators in theory of flight is generally not provided.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum.

TABLE 50. FAR AND RELATED PUBLICATIONS

	N A O L S	F A O L S	T A O L S	A/S A O L S	I A O L S
USE SPECIFICATIONS, DATA SHEETS, MANUALS, AND PUBLICATIONS ON AIRCRAFT, ENGINES AND PROPELLERS	+ + + +	H H H H	3 2 3 3	1 1 2 1	3 3 3 1
USE REQUIRED FEDERAL AIR REGULATIONS	+ + + +	H H H H	3 3 3 3	1 1 1 1	3 4 3 1
INTERPRET AND USE SPECIFICATIONS SUCH AS MS, AC, AN, NAS AND TYPICAL MANUFACTURER'S MANUALS	+ + + +	H H H H	3 3 2 3	1 1 1 1	3 1 4 1
INTERPRET AND USE ATA SPECIFICATION 100	+ + + +	H H H H	2 3 3 3	1 1 1 1	3 1 3 1
USE FLIGHT SAFETY MECHANICS BULLETINS	+ + + +	H H H H	3 3 2 3	1 1 1 1	3 4 1 1
KNOW HOW AND WHERE TO FIND PERTINENT DATA IN FAA SPECIFICATIONS	+ + + +	H H H H	3 1 3 3	1 2 1 1	3 3 3 1
USE OF LOGBOOKS AND MAKING MAINTENANCE RECORD ENTRIES	+ - + +	H H H H	3 3 3 3	1 1 1 1	3 3 3 1
USE AND DISPOSITION OF FAA FORMS	- + + +	H H H H	3 3 3 3	1 1 2 1	3 3 3 1
USE AIRWORTHINESS DIRECTIVES (FAR 39)	- + + +	H H H H	3 2 3 3	1 1 1 1	3 3 3 1
FILE AND INDEX PUBLICATIONS	$ $ + +	H H H H	3 1 3 3	1 1 1 1	3 3 3 1
USE OF TECHNICAL STANDARD ORDERS (TSO) AND SUPPLEMENTAL TYPE CERTIFICATE (STC)	$ + +	L H H H	3 2 3 3	1 1 1 1	3 3 3 1

TABLE 50

FAR AND RELATED PUBLICATIONS

OVERVIEW OF WORK PERFORMED

Mechanics must be able to use FAA forms, Airworthiness Directives, logbooks, Technical Standard Orders, Federal Air Regulations, and Flight Safety Mechanics Bulletins. They must know where to find and how to apply such data in maintaining aircraft.

PRINCIPAL FINDINGS

F - All mechanics indicate that they use FAR and related publications, but airline line mechanics rarely use Technical Standard Orders.

A/S- General aviation mechanics must be accurate in the use of publications and FAA forms and be able to find this information rapidly.

I - The airlines provide depth training to their overhaul mechanics in the use of Federal Air Regulations and Flight Safety Mechanics Bulletins. Mechanics employed by large general aviation companies are trained to use and interpret manufacturer's manuals. Small general aviation companies do not provide training in FAR and related publications.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum.

TABLE 51. SHOP MANAGEMENT RESPONSIBILITIES

	N A O L S	F A O L S	T A O L S	A/S A O L S	I A O L S
MAINTAIN REQUIRED RECORDS	+ + + +	H H H H	3 3 3 3	1 1 1 1	3 3 3 1
APPLY FAA REGULATIONS IN REPAIR STATION OPERATION	$ + + +	H H H H	3 3 3 3	1 1 1 1	3 1 3 3
APPLY SHOP MANAGEMENT PRINCIPLES TO ORGANIZATION AND ASSIGNMENT OF PERSONNEL	$ + + +	H H H H	3 3 3 3	1 2 2 1	4 3 3 1
PURCHASE PARTS AND SUPPLIES	- + + +	H H H H	3 1 3 3	1 1 1 1	2 2 1 1
PERFORM ELEMENTARY ACCOUNTING	- + + +	H H H H	3 3 3 3	1 2 1 1	1 3 3 1
PERFORM INVENTORY CONTROL OF MATERIALS, EQUIPMENT	$ $ + +	H H H H	3 1 3 3	1 2 1 1	2 3 1 1
PERFORM JOB ESTIMATING	$ $ + +	H H H H	3 1 3 3	1 2 1 1	1 1 1 1

TABLE 51

SHOP MANAGEMENT RESPONSIBILITIES

OVERVIEW OF WORK PERFORMED

Mechanics should know the business principles and economics of operating an aircraft maintenance business. Such understanding helps promote work efficiency within an organization. Fundamentals of elementary accounting, job estimating, and inventory control must be a part of the mechanic's knowledge if he plans to work for himself or for a small aviation company.

PRINCIPAL FINDINGS

N - All industrial categories indicate that mechanics have shop management responsibilities.

F - All mechanics perform these tasks at a high rate of frequency.

T - The technical knowledge level for most subtopics is at the application level, although airline overhaul mechanics are not generally responsible for purchasing, inventory control, or job estimating.

I - Airline line mechanics receive in-depth management training with regard to organization and assignment of personnel.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum.

TABLE 52. ETHICS AND LEGAL RESPONSIBILITIES

	N				F				T					I			
	A	O	L	S	A	O	L	S	A	O	L	S		A	O	L	S
EMPLOY ETHICAL PRACTICES RELATED TO																	
JOB AND PRODUCT PRIDE AND CRAFTSMANSHIP	+	+	+	+	H	H	H	H	5	5	5	5		2	3	3	1
MECHANIC-EMPLOYER RELATIONSHIP	+	+	+	+	H	H	H	H	5	5	5	5		3	3	3	1
THE RESPONSIBILITIES OF AVIATION	+	+	+	+	H	H	H	H	5	5	5	5		3	3	3	1
PERSONAL CONDUCT AND INTEGRITY	+	+	+	+	H	H	H	H	5	5	5	5		3	3	3	1
PRACTICE THE LEGAL RESPONSIBILITIES OF																	
LIABILITY OF THE CERTIFICATED MECHANIC	+	+	+	+	H	H	H	H	5	5	5	5		3	3	3	1
EMPLOY ETHICAL PRACTICES RELATED TO																	
MECHANIC-CUSTOMER RELATIONSHIP	+		+	+	H	H	H	H	5	5	5	5		2	3	3	1
PRACTICE THE LEGAL RESPONSIBILITIES OF																	
BAILMENT			+	+		H	H	H		5	5	5			4	3	1
MECHANICS LIENS			+	+		H	H	H		5	5	5			4	3	1

TABLE 52

ETHICS AND LEGAL RESPONSIBILITIES

OVERVIEW OF WORK PERFORMED

Mechanic-customer relations are important to the success of a business. Good labor-management relationships contribute to the mechanic's advancement and financial security. Good personal conduct and unquestionable integrity are as important for the mechanic as for any individual. Mechanics must be technically competent, have pride of craftsmanship, and be dedicated to safety in aviation. The individual mechanic must also be aware of his legal liabilities and responsibilities.

PRINCIPAL FINDINGS

N - All industrial categories indicate that the mechanic must be constantly aware of his ethical and legal responsibilities.

T - All industry indicates that pride of craftsmanship, personal conduct, integrity, liability, and the responsibility of the certificated mechanic must be at the synthesis level.

I - Although airline line mechanics indicate that they have no need for the knowledge implied by the subtopics "bailment" and "mechanics liens," a select group of airline overhaul mechanics are given in-depth training in these two subtopics.

NATIONAL ADVISORY COMMITTEE RECOMMENDATIONS

All subtopics should be included in the aviation mechanics core curriculum.

DISCUSSION OF FINDINGS

A review of the data received from the aviation industry during the survey suggests that certain trends are developing. In addition, some of the findings reinforced some opinions expressed in aviation circles, while other findings reveal that certain opinions cannot be substantiated or are no longer applicable to the aviation industry. A compilation of these trends follows.

1) There is a common core of tasks performed by all aviation mechanics requiring the same technical knowledge levels.

The National Advisory Committee parameters applied to the survey data showed that all aviation mechanics performed to the same technical knowledge levels in 63 percent of the subtopics. Another 10 percent of the subtopics were found to be performed to identical technical knowledge levels by mechanics in three of the four industrial categories. The total common technical knowledge levels involve 73 percent of the subtopics. This high percent of the commonality of tasks performed by aviation mechanics in the four industrial categories strongly supports the premise that aviation mechanics can be trained through a core curriculum and can specialize in the latter part of their training for the industrial category in which they may seek employment.

2) The predominant technical knowledge level at which the aviation mechanic works is the application level or higher.

When all the subtopics had been analyzed, 86 percent were found to have been rated by mechanics in at least three of the industrial categories as requiring technical knowledge at the application, or a higher, level. Mechanics indicated they can accomplish the remaining 14 percent of the subtopics with either the knowledge and/or comprehension level of technical knowledge, which require the ability to follow directions and/or to locate and interpret information. These findings substantiate the need to train aviation mechanics to the application level so that transfer of learning to industry is easily accomplished.

3) Many airline overhaul mechanics are specialists in the particular area of work for which they receive extensive training.

With the exclusion of the subtopics in Tables 44-52, it is found that the airline overhaul mechanic performs 393 of the 437 subtopics in the remaining tables. Of these, 364 tasks were performed by less than 5 percent of the mechanics for each of the subtopics. These specialized mechanics received in-depth training for 54 percent of these subtopics, basic or general information training for 43 percent, and orientation or no training for the remaining 3 percent.

4) There is an increasing use of turbine engines in general aviation.

During the period of one year that elapsed between the California survey and the national survey, the percent of general aviation mechanics performing overhaul work on turbine engines increased from "No mechanics" among those surveyed in 1965 to 5 percent of those surveyed in 1966. Following examination of the responses for the 507 subtopics by small general aviation, it was noted that training in depth was provided for only 10 tasks. Seven of these, however, were in subtopics associated with turbine engines. The influx of turbine engines into general aviation suggests the need for in-depth training for those currently employed. This need for well-trained turbine mechanics should be reflected in the school curriculum.

5) The majority of airline mechanics no longer work on reciprocating engines having less than 14 cylinders.

No airline mechanics responded to any task required for maintenance or overhaul of a reciprocating engine of less than 14 cylinders. This finding is particularly significant in view of the fact that the results of this survey represent tasks performed by 15,258 airline mechanics. General aviation mechanics, however, are deeply involved in checking, servicing, repairing, and overhauling four- or six-cylinder opposed engines and seven- or nine-cylinder radial engines.

6) Fixed pitch wood propellers and ground adjustable propellers no longer appear in airline operation. Their number is decreasing in general aviation.

According to the survey data, airline mechanics do not work on fixed pitch wood propellers or ground adjustable propellers. The work that is most frequently accomplished in general aviation on ground adjustable propellers involves minor repairs to the blade and hub. Large general aviation companies frequently remove and install these propellers but all other subtopics in large and small general aviation are performed at a low frequency.

7) Electricity and electronics are becoming integrated into the airframe and powerplant mechanic's occupation.

The mechanics in the airline industry and in large general aviation companies performed all 28 tasks surveyed in the areas of electricity and electronics at a high frequency. Mechanics in small general aviation also performed all tasks at a high frequency, with the exception of checking and troubleshooting solid state switching devices. All indications point to the necessity for the schools to increase the emphasis in the instruction of electricity and electronics in the aviation mechanics' courses.

8) The maintenance of flight instruments, automatic flight and approach control systems, and aircraft communications and navigation equipment is extremely specialized work.

The airline industry generally provides training in depth for mechanics doing maintenance work on flight instruments, automatic approach control systems and communications, and navigation systems. Mechanics in large general aviation receive training in depth in maintenance of auto pilots and approach control systems and application training in all other related areas. Mechanics in small general aviation receive basic and general information training in the basic flight instruments but generally receive no industry training in any other related areas. Specially certificated mechanics and specialized shops frequently repair these systems. The National Advisory Committee has recommended that schools teach to the comprehension level in these specialties.

9) The need for mechanics skilled in woodworking has decreased substantially in the aviation industry.

The survey found that the airline industry no longer requires mechanics to be skilled in woodworking. Few highly specialized airline overhaul mechanics perform wood repairs to interior cabinets and paneling. Large general aviation companies assign these tasks to a few mechanics who perform these tasks at a low frequency. Of 2,463 large general aviation mechanics surveyed, only 174, or 7 percent, indicated that woodworking was part of their assignment. In small general aviation, woodworking continues to be performed by approximately one-third of the mechanics, but the frequency is in the low category. It was found that of 359 mechanics, only 126 were involved in woodworking tasks. The overall percentage of aviation mechanics surveyed in general aviation, large and small, who are responsible for performing woodworking is 10.8 percent.

10) Aviation mechanics must understand the basic operations involved in sheet metal work and must be able to make return to flight repairs to metal structures.

Findings reveal that the aviation industry requires more men to possess skill and knowledge in this topic area than in any other subtopic requiring manipulative skill. Representatives of the aviation industry stated that the mechanic must know which types of damage can be tolerated and which need repair. In all cases the work must be of a return-to-flight standard.

11) Aircraft welding is becoming a specialized skill.

The introduction of new materials in aviation and the new welding techniques require specialized skills for welders. Comments received from general aviation companies indicate that repairs involving welding are done by specialty shops. Specialization in welding is also applicable in the airline industry. In order to become a certificated welder, a mechanic must receive specialized instruction.

12) The use of manufacturer's specifications and Federal Air Regulations are an essential part of the aviation mechanics occupation.

Mechanics in all four categories indicated that manufacturer's specifications and Federal Air Regulations are used at a high frequency. The number of mechanics who use these publications and manuals is also very high. The airline industry and large general aviation provide basic and general information training in these tasks.

13) To be employable, the mechanic must have a sound command of the English language.

The importance of a mechanic's ability to read, write, and speak the English language is in most cases a fundamental requirement for acceptable performance and for advancement in the industry. Industry personnel repeatedly stressed during the survey that if a mechanic cannot meet this requirement in a satisfactory manner, he is not employable. The number of mechanics and the frequency with which this major topic is required is understandably very high. Accuracy in the use of the English language was emphasized throughout the findings. However, large general aviation required both accuracy and speed. The schools have a responsibility to ensure that their students are able to meet the standards for performance required in this area.

14) Ethics and the mechanic's legal responsibilities are an important part of the aviation mechanic's training.

This is the only major topic in the study where the subtopics were consistently ranked at the synthesis level in technical knowledge by all industrial categories. Since the definition of the synthesis level would be at times difficult to apply in this area, it only tends to emphasize how strongly the industry feels about the importance of the ethical responsibilities of the mechanic. The survey indicates that the widespread and high frequency requirements for the mechanic's integrity, quality of workmanship, and responsible action in the work environment will continue to be an essential part of the occupation.

15) The aviation industry provides extensive in-service training for the maintenance of occupational currency.

The in-service training for mechanics is designed to provide currency when new models of aircraft are introduced and changes occur in existing models. The amount of training is substantial and is generally directed to the basic and general information level. Training in depth is most predominant in the airline overhaul category. Industry training ranged from 81 percent in airline line stations to 85 percent in airline overhaul stations in all subtopics. Training in the general aviation industry ranged from 66 percent in small general aviation to 92 percent in large general aviation for all subtopics.

Redirection, Application, and Projections

Redirection

To ascertain the direction aircraft mechanic schools should take in developing an effective aviation mechanic's instructional program, an analysis of the training provided by industry and the schools should be made. This study, plus a subsample study that is discussed in detail in this section, identified industry's efforts to provide instructional programs for aviation mechanics. A review of the school programs in ATEC's 1965 Survey of Federal Aviation Agency Approved Mechanic School Programs outlines the efforts made by aviation mechanic schools to train aviation mechanics.

INDUSTRY EFFORTS

Two studies were made to determine what the aviation industry was doing to provide training for the certificated mechanic. The first of these was the national Study of the Aviation Mechanics Occupation; the second was the subsample study whose objective was the examination of the recency of the mechanics' in-service training, which was undertaken on the recommendation of the National Advisory Committee.

In the Study of the Aviation Mechanics Occupation it was found that industry training efforts for aviation mechanics ranged from orientation through basic or general training to training in depth. A number of the subtopics represented tasks for which industry offered no training.

As shown in Fig. 6 following, industry's training efforts are concentrated on basic and general information training. The training provided is designed to keep mechanics current with new models of aircraft and the changes that occur in existing aircraft. Training in depth is shown to be more prevalent in the airlines than in general aviation.

LEVEL TO WHICH TRAINING IS OFFERED	INDUSTRIAL CATEGORIES OFFERING TRAINING			
	Airline Line	Airline Overhaul	Large General	Small General
No training	19%	15%	8%	34%
Orientation or familiarization training	7%	4%	4%	zero
Basic or general information	55%	39%	72%	63%
Training in depth	19%	42%	16%	3%

Fig. 6. Percent of subtopics for which training is given by the aviation industry

The second study was the subsample study to examine recency of in-service training. The questionnaire was designed to answer three major questions: When was in-service training last received by the mechanic; where was instruction obtained (schools, industry, or both); and what type of instruction was received (formal, informal, or correspondence).

A total of 446 subsample questionnaires were completed by mechanics representing all four industrial categories. The distribution of the responses was: airline line stations, 234 mechanics; airline overhaul stations, 59 mechanics; large general aviation companies, 112 mechanics; and small general aviation companies, 41 mechanics.

Incidental information shown on the questionnaire regarding the mechanics' date of certification and the type of in-service training they received in each of the 52 major topics used in the national study was also examined. The subsample survey instrument was not designed to correlate the major topics with the type of training received and where the training was given.

Date	No.	Date	No.	Date	No.	Date	No.	Date	No.
1930	1	1939	2	1946	20	1953	16	1960	24
1931	1	1940	4	1947	34	1954	10	1961	14
1932	1	1941	4	1948	18	1955	25	1962	14
1933	2	1942	8	1949	17	1956	22	1963	15
1934-36	0	1943	5	1950	20	1957	17	1964	18
1937	1	1944	6	1951	17	1958	23	1965	25
1938	3	1945	13	1952	10	1959	29	1966	1

Fig. 7. Date of certification and number of respondents certified by year

The mechanics who responded to the subsample survey reported having received their certificates during the past 36 years (Fig. 7). None of the respondents was certified during the years 1934, 1935, and 1936. Beginning in 1945, an averag. number of 20 respondents received their mechanic certificates each year. The increase in the number of certificates issued in 1947 may be explained as an effect of the Serviceman's Readjustment Act of 1944.

Figure 8 following displays the years in which in-service training was last received. No in-service training was reported for the years 1945, 1946, 1949, 1950, 1951, and 1952. Of the 446 mechanics who responded, 383 men, or 86 percent, reported in-service training received since certification. The remaining 14 percent of the mechanics reported no in-service training received since certification.

Figure 8 also shows that 269, or 70 percent, of the respondents received in-service training in 1965 and 1966; an additional 56 mechanics, or 15 percent, reported in-service training received in 1964; and 26 respondents, or 7 percent, indicated in-service training received in

1963. Thus, a total of 92 percent of the respondents is shown to have received in-service training within the last three years. The training reported by the remaining 8 percent during the following periods is shown to have occurred in this distribution: 1960-62, 16 mechanics (4%); 1954-59, 11 mechanics (3%); and 1944-53, 5 mechanics (1%). Years in which no training was received have been omitted from Fig. 8.

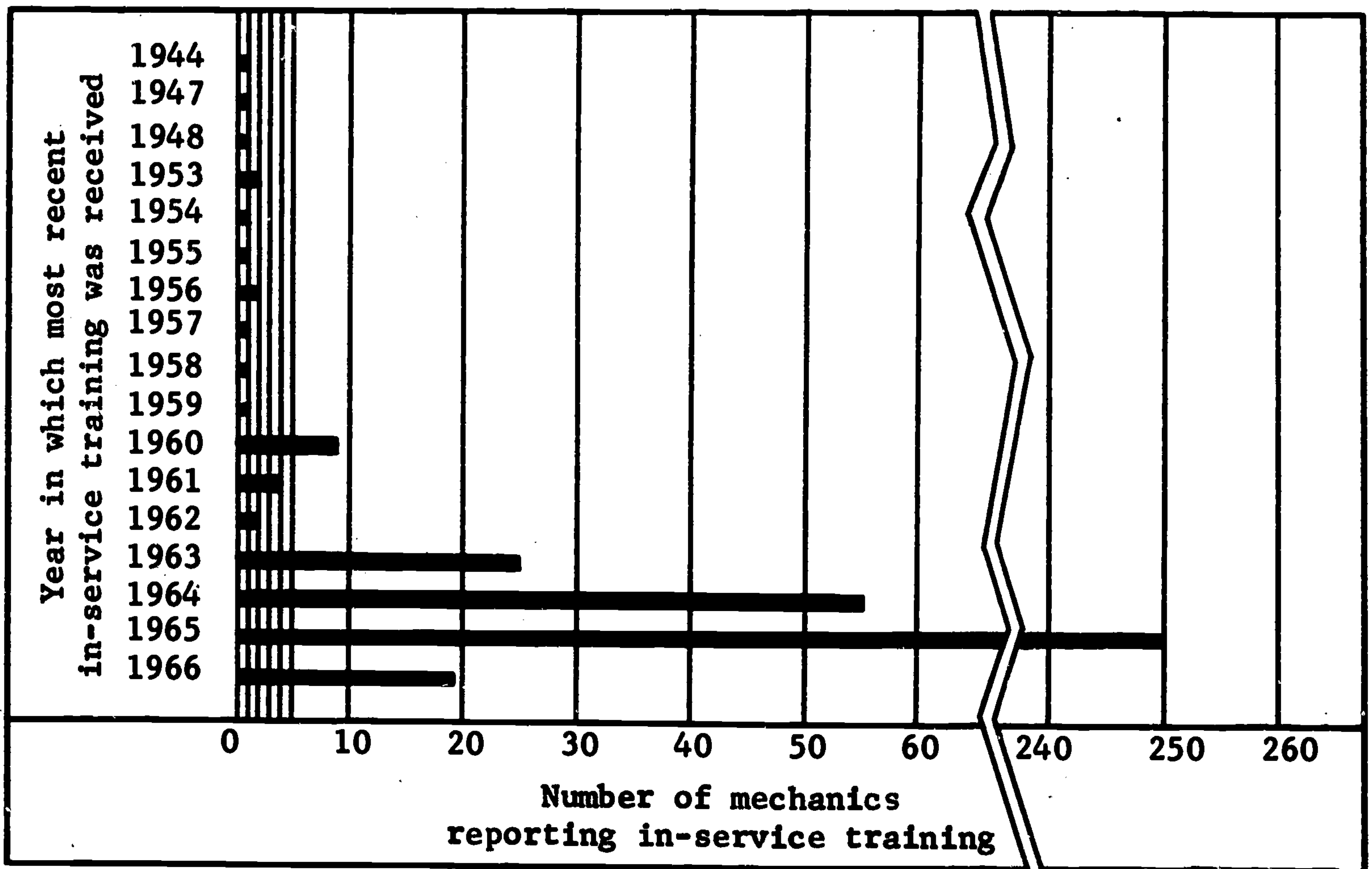


Fig. 8. Mechanics' in-service training

A review of Fig. 9 opposite reveals that formal instruction was the most common approach to in-service training. In descending order of frequency, the combination of both formal instruction and informal on-the-job training was the next most frequently used; informal on-the-job instruction was the third most frequent approach to in-service training. Only mechanics employed in the small general aviation industry indicated that they had received in-service training solely through correspondence courses.

TYPE OF INSTRUCTION	A	O	L	S
Formal classroom instruction	40%	40%	30%	28%
Informal on-the-job instruction	7%	10%	14%	17%
Combination of formal and informal instruction	18%	17%	20%	17%
Correspondence courses	--	--	--	2%
Formal instruction and correspondence courses	5%	10%	1%	2%
Informal instruction and correspondence courses	2%	--	2%	7%
Combination or formal, informal, and correspondence courses	18%	13%	5%	2%
Indicated no in-service training	10%	10%	28%	25%

Fig. 9. Means by which in-service training was obtained

Figure 10 presents evidence that in-service training is provided by both industry and the schools. The respondents to the subsample survey reported that most of their in-service training was provided by the aviation industry. This data supports the findings in this study, which

	IN-SERVICE TRAINING PROVIDED BY:		
	Industry	Schools	Both
Airline line mechanics	164	16	41
Airline overhaul mechanics	44	2	7
Large general aviation mechanics	66	3	10
Small general aviation mechanics	24	5	1

Fig. 10. Sources of in-service training

also indicated that industry is providing much training to maintain the technological currency of the aviation mechanic.

Application

In addition to teaching the various levels of technical knowledge recommended by the National Advisory Committee, the schools should develop and use written and manipulative examinations to determine that the level of teaching had been reached. These examinations may provide information concerning the student's rate of progress toward the established educational objectives for the subtopics contained in their school curriculum. A review of these levels and correlated sample questions follow. The examination material that appears in this section of the study has been adapted in part from the Study of the Aviation Mechanics Occupation (California study) published earlier in 1966.

TEACHING LEVEL 1: TESTING LEVEL, KNOWLEDGE

The subtopics to be taught at this level should be based on Instructional Setting A or E. The instruction should help the student learn to follow directions and to find information. The student should be expected to store some information and be able to recall this information later. Sample written questions to be given at the knowledge level are as follows:

1. The ratio of the speed of an aircraft to the speed of sound in air at any given temperature is called (the):

   a. Reynold's number
   b. Mach number
   c. Speed-temperature ratio
   d. Inlet-exhaust pressure ratio

2. Basically, the aircraft gas turbine engine operates under the description of the:

a. Otto cycle engine
b. Brayton, or Joule, cycle
c. Constant pressure engine
d. Constant volume engine

3. Ohm's Law is stated in which one of the following formulas?

a. I = R/E
b. E = IR
c. R = EI
d. I = IRE

TEACHING LEVEL 2: TESTING LEVEL, COMPREHENSION

The subtopics to be taught at this level should be based on Instructional Setting B or F. The student should be able to grasp the meaning and intent of the instruction. He should have an ability to interpret information in manuals, blueprints, and other related diagrams and drawings needed in performing a task. Sample questions at the comprehension level are as follows:

1. Based on the given cable chart, what size cable is required to carry 200 amps at 28 volts for a distance of 25', under intermittent conditions, to a turbine engine starter?

a. #2
b. #4
c. #6
d. #8

2. Based on the accompanying aircraft specifications, to which one of the following maximum weights may an aircraft in the utility category be loaded without exceeding the c.g. limits of +36.3" to +40.3"?

a. 1,733 lbs.
b. 2,200 lbs.
c. 3,453 lbs.
d. 4,000 lbs.

3. "Valve overlap" may be defined by which one of the following statements?

a. Improperly lapped valve seats
b. Degrees of crank rotation during which the exhaust and intake valves of a cylinder are both open
c. Undercutting of valve faces during lapping
d. Improper clearance adjustment between the valve stem and tappet

An examination in the performance of a manipulative skill could require a student to interpret engine overhaul limits from a manual, using these limits to inspect for wear of engine parts. Another type of test could require a student to compute, through the bend allowance formula, a sheet metal part containing several different angular bends.

TEACHING LEVEL 3: TESTING LEVEL, APPLICATION

The subtopics to be taught at this level should be based on Instructional Setting C or G. The student should develop knowledge of principles and processes and learn to apply them to specific situations. The student must remember appropriate principles and be able to apply them to new material. The instruction should provide detailed training in both technical and manipulative skills so that recall can be easily accomplished after the student has been employed and given additional review. Sample questions at the application level are as follows:

1. The purpose of a brake de-booster is to lower the pressure of the hydraulic system when applying the brakes by:

a. Providing a larger piston area for the hydraulic pressure to act upon
b. Providing a smaller piston area for the hydraulic pressure to act upon
c. Isolating the system pressure from the lower pressure
d. Installing a restrictor in the line to the brake

Below are statements that may support the selection of your answer above.

Circle the number of those statements that support your answer:

1. A restrictor causes a pressure drop, thus lowering pressure.
2. Increased piston area increases pressure.

3. Decreased piston area increases pressure.
4. Increased piston area decreases pressure.
5. Decreased piston area decreases pressure.
6. Force is equal to the product of pressure and area.
7. Force is equal to pressure per unit area.
8. Secondary system pressure to brakes is isolated by second pump.
9. The brake has its own pressure regulator.
10. Venturi effect of a restrictor increases velocity and decreases pressure.

2. Bernoulli's Principle indicates that if a smaller venturi is used in a carburetor, it will:

a. Decrease the air velocity and pressure
b. Increase the air velocity and decrease the pressure
c. Increase the air pressure and obtain more power
d. Increase the flow of air and gasoline

In relation to your answer, the following statements are true or false. If the statement supports your selection, circle the "T"; if it does not, circle the "F."

T F A smaller venturi will decrease manifold pressure.
T F A large venturi permits higher engine RPM.
T F Air pressure increases as the square of the velocity.
T F A smaller venturi will increase manifold pressure.
T F A large venturi is more effective at take-off power.
T F A smaller venturi makes the idle system more effective.
T F A small venturi increases the pressure at the discharge nozzle.
T F A large venturi provides more manifold pressure.
T F More air flow through the venturi causes more gas consumption.
T F A smaller venturi is more effective at higher altitudes.

3. If a shunt wound generator has a short between the armature and field:

a. The output will drop to zero
b. The generator will run away
c. The circuit voltage will drop
d. The "D" lead voltage will increase

By circling the numbers in front of the items below, indicate those you would use to check for the trouble you identified above:

1. Check resistance of generator field.
2. Check for shorted brushes.
3. Check for broken bearing.
4. Check reverse current relay.
5. Readjust current limiter.

6. Readjust voltage regulator.
7. Check resistance from "D" lead to ground.
8. Check armature to see if it is hitting the pole shoes.
9. Check ammeter for accuracy.
10. Check generator for sheared shaft.

An examination for manipulative skill should require the student to plan his work, select the proper tools, perform the job in sequence, complete the job in a reasonable time, and turn out a finished product that meets high standards of workmanship, accuracy, and dependability. The performance test must give a realistic appraisal of the student's ability. A check list should be used to evaluate the student's performance during the examinations and his overall rating. The check list items should be stated so that an objective rating may be established.

TEACHING LEVEL 4: TESTING LEVEL, ANALYSIS/SYNTHESIS

The subtopics to be taught at the analysis and the synthesis level should be based on Instructional Setting D or H. The student should develop the ability to reduce a malfunction to its fundamental parts in order to troubleshoot or make necessary repairs. The instruction must include training in depth in both technical and manipulative skills to facilitate transfer of learning with minimum difficulty. Through analysis, the students should be able to break down each job into its parts and examine the relationships between the parts. Sample questions at the analysis/synthesis level are as follows:

1. The following logbook item is written for an aircraft having "spot brakes": Upon application, brakes were inoperative." Check the items below that you would use in troubleshooting the item. Begin by writing the number "1" in front of the first item you would check, and continue numbering in the sequence you would use to isolate the trouble.

____Check for air in the brake lines.
____Check for broken brake accumulator diaphragm.
____Check hydraulic tank for fluid.
____Check system pressure.

____Check for disconnected link between brake pedal and metering valve.
____Check for pucks missing from spot brake.
____Check for broken line downstream of brake metering valve.
____Check for ruptured brake cylinder.
____Check for too great a brake clearance.
____Check for leak in main system.

2. The following logbook entry appears concerning an aircraft with Hamilton Standard Constant Speed Propeller: "Upon take-off, propeller emains in low pitch. Unable to increase propeller pitch angle. See previous logbook entries." Upon reviewing the logbook, you find that two governors have been replaced because of broken drive shafts. You suspect one of the following troubles:

a. Malfunction in the engine oil system
b. Improper torqueing of governor
c. Internal engine damage

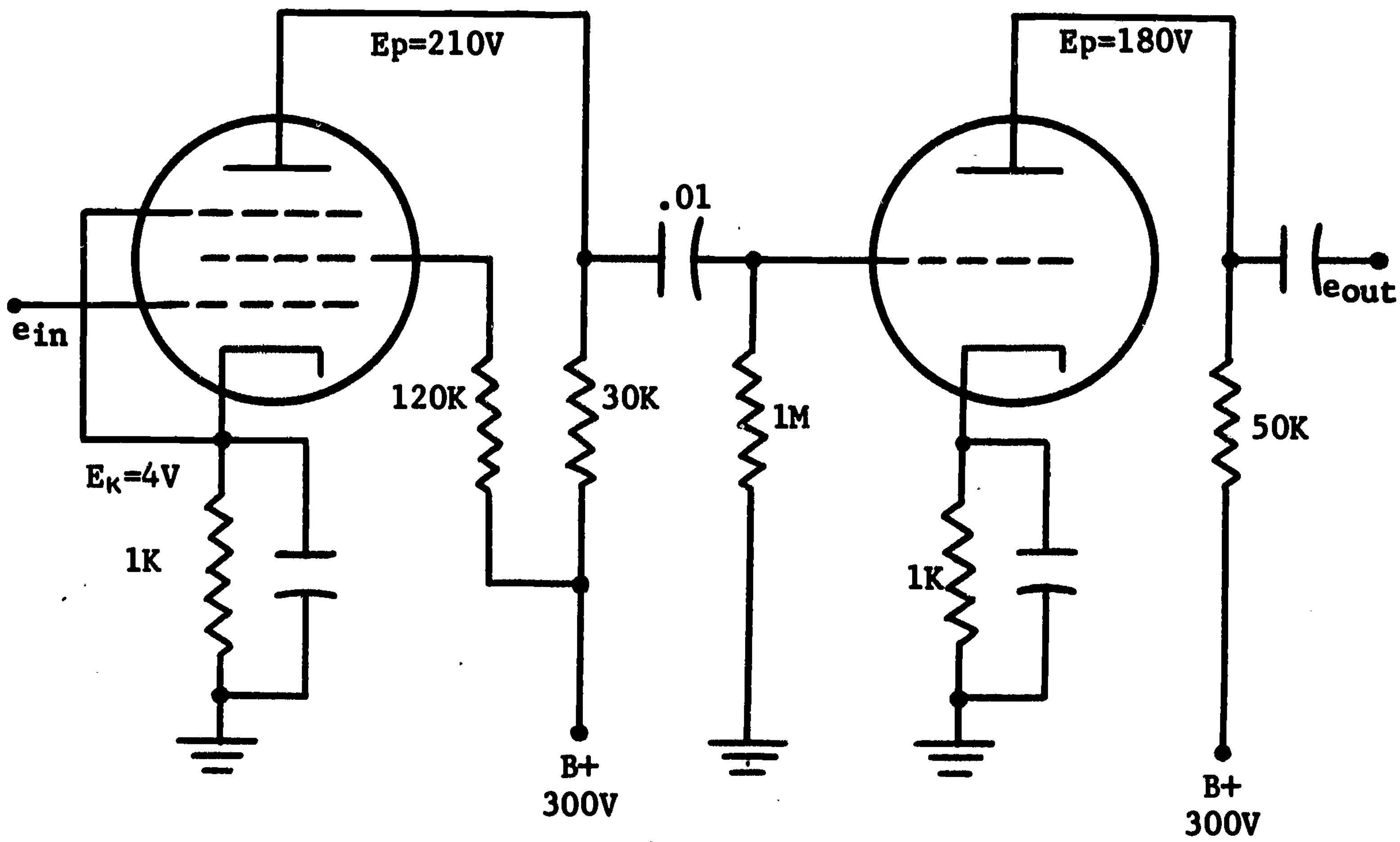
Based on your selection, indicate by numbers the sequence you would follow to solve the problem you selected as the cause of the trouble.

Engine oil system
____Check oil level.
____Check oil pressure.
____Check for oil leakage around dome.
____Check for proper oil viscosity.

Improper torqueing of governor
____Check stress on threads of nuts.
____Check for proper gasket.
____Check for stud stretch.
____Check break-away torque.

Internal engine damage
____Check for slipping drive spline.
____Check for proper length of governor shaft.
____Check for missing tooth on drive gear.
____Check for damage spline on drive spline.

3. A 2-stage amplifier is used to position a wastegate motor. During service, the motor becomes sluggish. The motor and interconnecting wiring checks out OK. A mechanic suspects the amplifier. Several quiescent voltage readings are indicated on the wiring diagram in the maintenance manual; however, the V_1 screen grid voltage is not indicated. What should this voltage be?



a. 80 volts
b. 120 volts
c. 180 volts
d. 210 volts

This voltage was arrived at by one of the following methods of analysis. Which of these was used?

1. The screen voltage and plate voltage are the same.
2. The screen voltage equals the supply voltage minus the IR drop.
3. Screen grid current is zero.
4. Cathode current is zero.
5. No signal is applied under quiescent conditions.
6. The amplifiers are both operating as class "A."
7. There is not enough information given above.

A performance test should not only include the standards and methods used for testing at the application level, but should also measure how well and quickly a student can identify and isolate the cause of a malfunction. Many schools have students troubleshoot engines, hydraulic systems, electrical systems, etc., that have been made to function improperly, and these types of tests meet the requirements of an analysis examination. However, as in the case of the application level examinations, a check list should be used that will give objective ratings of the student's performance during the examination.

Instruction at the synthesis level requires the student to develop the ability to put together knowledge of principles and procedures needed to complete repairs. This includes the construction of new or substitute parts. The instruction presented to the student must be in depth both in technical and manipulative skill to facilitate transfer of learning with minimum difficulty. Although few subtopics recommended for instruction are at the synthesis level, those that are should call upon the student to demonstrate his ability to create original repair ideas within limits of time and material. The following problem example is appropriate for this level of instruction. Taken from the flight crew logbook, the information concerns an axial compressor turbine engine.

"During start of descent from 30,000 ft., while at 500 KTAS, No. 4 engine experienced a compressor stall lasting approximately 3 secs. as all four throttles were being retarded from the 85% thrust to idle position. Other observed conditions for No. 4 engine were: (1) fuel flow increased from 3,000 pph to 3,500 pph; (2) engine speed dropped to 5,000 rpm from 10,000 rpm; (3) exhaust gas temperature increased to 650°C."

The student is required to write a comprehensive report of the problem. The report should contain an analysis of the probable causes of the malfunctions, a detailed outline of the inspection to be performed on the engine, a list of repairs to be made, and the scope of engine testing to be done before the aircraft is released to flight status.

An examination of manipulative skill could require the student to develop a creative design or procedure for the repair or maintenance of an aircraft or one of its components. The examination must permit creative answers, and the student should have time to develop his answer. The test may require the student to design a new structural repair by outlining the sequential steps needed to perform the job, designing and fabricating the new parts required, and then completing the entire job. Many students will not be able to perform completely at the synthesis level; however, instruction at Level 4 should give the student training that will permit him to work in industry at a high level of proficiency.

The information accumulated during the national survey and the recommendations of the National Advisory Committee together identify the subtopics that compose the core curriculum for the aviation mechanics course of instruction. Use of the suggested levels of instruction in this curriculum will assist aviation mechanics schools in their efforts to provide more effective instruction.

OUTLINE OF CORE CURRICULUM

The following core curriculum is a compilation of the recommendations made by the National Advisory Committee. The curriculum lists and identifies the teaching and testing levels for each of the subtopics. Following this curriculum outline is a compilation of all other subtopics that were surveyed and recommended for deletion from the core curriculum. It is suggested that schools review these deleted topics and, upon recommendation of their local advisory committee, utilize the information presented for curriculum construction that would best serve their local needs.

In reading the following curriculum, it should be noted that the subtopics are listed under the Teaching Levels: 1, 2, 3, or 4, and the Testing Levels: Knowledge, Comprehension, Application, or Analysis/Synthesis.

WOODWORK

Level 1 - Knowledge

Make rib repair
Use glues and clamps
Build a rib
Build wing section
Make spar splice
Use NACA airfoil specifications
Construct jigs
Select materials
Handle and store wood
Test strength of splices
Make approved splices

Level 2 - Comprehension

Identify wood defects

FABRIC COVERING

Level 1 - Knowledge

Select materials
Cover wing, structure, or control surface

Level 2 - Comprehension

Perform hand sewing

Level 3 - Application

Repair fabric
Perform fabric protection and testing

PAINTING AND FINISHING

Level 1 - Knowledge

Lay out letters and mask
Lay out trim design
Touch up painting

Level 3 - Application

Brush painting
Spray painting
Inspect and identify defects
Prepare surface and prime
Apply dope

SHEET METAL

Level 1 - Knowledge

Maintain aerodynamic smoothness

Level 2 - Comprehension

Install special rivets
Install special fasteners
Fabricate from template
Develop template from blueprint
Shape metal, i.e., hot working, cold working, casting, chemical milling, etc.

Level 3 - Application

Hand forming
Use bend allowance
Identify and control corrosion (Theory only.)
Repair structure
Use adhesive metal bonding
Inspect and repair plastics and fiberglass
Repair honeycomb and laminated structure

Level 4 - Analysis/Synthesis

Install conventional rivets
Dimple metal
Make patches
Protect metal from damage (No manipulative skill training.)

WELDING

Level 1 - Knowledge

Solder stainless steel
Fabricate tubular structures
Repair tanks
Weld magnesium
Weld titanium

Level 2 - Comprehension

Weld aluminum

Level 3 - Application

Solder
Identify types of welded joints (Theory only.)
Weld stainless steel

Arc welding
Control alignment while welding
Inspect and test welds
Weld steel (gas)
Braze

ASSEMBLY AND RIGGING

Level 1 - Knowledge

Use transit

Level 2 - Comprehension

Rig fixed surfaces
Rig aircraft
Tram and align structure

Level 3 - Application

Rig moveable surfaces
Balance control surfaces
Assembly of aircraft

Level 4 - Analysis/Synthesis

Use manufacturer's and FAA specifications

LANDING GEAR

Level 2 - Comprehension

Service and repair leveling devices
Service and repair anti-skid devices

Level 3 - Application

Service and repair landing gear
Inspect and replace tires and wheels
Service and repair shock struts
Service and repair nose wheel steering
Service and repair brakes
Jack aircraft and test gear
Inspect damage and wear to limits
Check alignment

HYDRAULIC AND PNEUMATIC SYSTEMS

Level 3 - Application

Operate and service hydraulic system and components
Operate and service pneumatic system and components
Identify various types of hydraulic systems
Identify various types of pneumatic systems
Identify hydraulic fluids
Install fittings and lines
Inspect and repair hydraulic system and components
Inspect and repair pneumatic system and components

Fabricate aluminum lines
Fabricate stainless lines
Select and install "O" rings and seals

FUEL SYSTEM

Level 1 - Knowledge

Service fuel dump systems
Repair and seal fuel tanks

Level 2 - Comprehension

Identify fuel systems

Level 3 - Application

Check and service fuel systems and components
Identify fuels
Fabricate and replace lines and fittings
Inspect and repair fuel system components

AIR CONDITIONING AND PRESSURIZATION

Level 2 - Comprehension

Check and service pneumatics and heat exchangers
Inspect, replace, or repair pneumatic system components (No manipulative skill training.)
Inspect, replace, or repair air conditioning components
Check and service heat and cooling systems and their control systems
Check and service aircraft pressurization and control systems
Inspect, replace, or repair pressurization components (No manipulative skill training.)
Inspect, replace, or repair oxygen systems and components (No manipulative skill training.)
Troubleshoot and repair air conditioning and pressurization systems

Level 3 - Application

Check and service oxygen systems

ELECTRICAL POWER

Level 1 - Knowledge

Apply electrical measuring and indicating devices for checking and measuring capacitance
Apply electrical measuring and indicating devices for checking and measuring inductance

Level 2 - Comprehension

Apply electrical measuring and indicating devices for calculation of resistance and conductivity
Check and replace transformers, rectifiers, and filters
Apply electron theory and fundamentals of electromagnetism in troubleshooting aircraft AC power systems

Apply electrical measuring and indicating devices for measurement and calculation of power
Test and repair aircraft generator and inverter control systems
Test and repair solid state inverters and switching devices

Level 3 - Application

Apply electron theory and fundamentals of electromagnetism in reading and analyzing DC and AC circuits and diagrams
Apply electron theory and fundamentals of electromagnetism in operation and testing DC and AC electrical components
Apply electrical measuring and indicating devices for measurement of voltage, current, and resistance
Apply electrical measuring and indicating devices for checking of continuity and electrical leakage
Promote and practice electrical safety and hazard precautions
Apply electron theory and fundamentals of electromagnetism in troubleshooting aircraft wiring and electrical installations
Troubleshoot and replace DC and AC motors and control units
Check and replace relays, solenoids, switches, and rheostats
Check and replace electrical protective devices
Apply electron theory and fundamentals of electromagnetism in troubleshooting aircraft DC power systems
Apply electrical measuring and indicating devices for checking and testing thermocouples
Troubleshoot and replace DC and AC generator equipment
Install and repair electrical wiring and distribution equipment
Apply battery theory and test equipment to maintain and test lead acid batteries
Apply battery theory and test equipment to test and maintain Edison cells and nickel cadmium batteries
Apply battery theory and test equipment to operate and maintain battery chargers
Check and troubleshoot solid state inverters
Inspect, test, and repair aircraft motors, generators, and inverters
Check and troubleshoot solid state switching devices

FLIGHT INSTRUMENTS

Level 2 - Comprehension

Troubleshoot and maintain magnetic compasses and heading indicators
Troubleshoot and maintain airspeed indicators and machmeters
Troubleshoot and maintain altimeters, rate-of-climb, and vertical speed indicators
Troubleshoot and maintain clocks and elapsed time indicators
Troubleshoot and maintain turn and bank, horizon, and yaw instruments
Troubleshoot and maintain temperature and pressure instruments
Troubleshoot and maintain flap and control surface position indicators
Troubleshoot and maintain pitot static, ram air, and vacuum systems
Troubleshoot and maintain resistance and thermocouple indicator systems
Troubleshoot and maintain synchro remote indication systems
Troubleshoot and maintain electronic indicating and computing systems
Troubleshoot and maintain integrated type of flight instrumentation

Test and repair compasses and heading indicator systems (No manipulative skill training.)
Test and repair airspeed, rate-of-climb, and altitude indicator systems (No manipulative skill training.)
Test and repair temperature and pressure indication systems
Test and repair electronic computers and integrating systems
Test and repair synchro systems and magnetic amplifiers

AUTO PILOTS AND APPROACH CONTROLS

Level 1 - Knowledge

Inspect, test and repair auto pilot control and interlock systems
Troubleshoot and maintain auto approach control
Inspect, test and repair auto pilot and approach control amplifiers, computers and couplers
Troubleshoot and maintain glide path extension and related data computers
Inspect, test and repair auto pilot flight control servos and drive mechanisms
Inspect, test and repair auto pilot signal source systems and units

Level 2 - Comprehension

Operate and check auto pilot and approach control systems (No manipulative skill training.)
Troubleshoot and maintain flight control servo units (No manipulative skill training.)
Check and troubleshoot auto pilot interlock systems (No manipulative skill training.)
Troubleshoot and replace auto pilot and approach control computers and amplifier units (No manipulative skill training.)
Troubleshoot and maintain auto pilot signal source units (No manipulative skill training.)
Troubleshoot and maintain power supplies and phase control (No manipulative skill training.)
Troubleshoot and maintain horizontal stabilizer control and mach trim systems (No manipulative skill training.)
Troubleshoot and maintain yaw damper systems (No manipulative skill training.)

AIRCRAFT COMMUNICATIONS AND NAVIGATION EQUIPMENT

Level 1 - Knowledge

Inspect and repair control units and panels
Check, troubleshoot and replace HF receiver and transmitter systems
Check, troubleshoot and replace service and passenger compartment interphone systems
Check and replace DME and DMET systems and off course computers
Check and replace weather radar systems
Check and replace selcal and transponder systems
Check and replace flight directors, data computers and integrating systems
Check and replace loran, doppler radar, radar altimeters
Check and replace radio altimeters and terrain clearance indication systems
Check and replace flight recorders

Level 2 - Comprehension

Inspect and repair antenna installations
Inspect and repair radio racks and related equipment
Inspect and repair radio and electronic wiring, switching and protective systems
Operate and check aircraft HF and VHF radio receivers and transmitters
Check, troubleshoot and replace VHF receiver and transmitter systems
Check and replace gyro and radio compass systems
Check and replace ADF and VOR systems
Check and replace marker, localizer, and glide slope receivers
Inspect and repair headsets, microphones, and speakers
Check, troubleshoot and replace flight compartment interphone systems

ENGINE INSTRUMENTS, ELECTRICAL

Level 1 - Knowledge

Troubleshoot and replace rate-of-flow indication systems

Level 2 - Comprehension

Troubleshoot and replace pressure indication systems
Inspect, test and repair engine indicating system components

Level 3 - Application

Inspect, test and repair electrical connections and wiring
Inspect, test and repair instrument panels and unit mountings
Inspect, test and repair electric connectors
Troubleshoot and replace temperature indication systems
Troubleshoot and replace tachometers and RPM indicators

AIRCRAFT FUEL AND OIL MEASUREMENT AND CONTROL

Level 1 - Knowledge

Calibrate and test capacitance fuel and oil quantity indication systems

Level 2 - Comprehension

Perform fuel management, transfer and defueling
Troubleshoot and replace fluid pressure and temperature indication systems
Troubleshoot and replace fluid system warning devices
Calibrate and test float type fuel and oil quantity indication systems
Inspect and repair fluid quantity indication equipment (No manipulative skill training.)
Troubleshoot and replace pressure refueling control equipment (No manipulative skill training.)

Level 3 - Application

Troubleshoot and replace fuel and oil electric pumps, valves and their controls
Troubleshoot and replace fluid quantity indication systems
Inspect and repair fuel and oil pumps, valves and other control units
Inspect and repair pressure and temperature indication and warning systems

AIRCRAFT LANDING GEAR ELECTRICAL UNITS

Level 1 - Knowledge

Inspect, test and replace speed warning components
Inspect, test and replace take-off warning components
Check and troubleshoot electrical brake controls and anti-skid control systems

Level 2 - Comprehension

Check takeoff warning systems (No manipulative skill training.)

Level 3 - Application

Troubleshoot landing gear position indication and warning systems
Check and troubleshoot ground flight changeover switches and relays
Inspect, test and replace landing gear and gear door switches
Inspect, test and replace ground flight switches and relays

FIRE DETECTION AND EXTINGUISHING SYSTEMS

Level 1 - Knowledge

Check and service smoke and carbon monoxide detection systems
Inspect, replace or repair smoke detection components

Level 2 - Comprehension

Check and service fire extinguishing systems (No manipulative skill training.)

Level 3 - Application

Check and service bimetallic, thermocouple and continuous strip fire detection systems
Inspect, replace or repair compartment fire detectors and system components
Inspect, replace or repair fire extinguishers and related system components
Inspect, replace or repair engine and nacelle fire detection components

ICE AND RAIN CONTROL

Level 2 - Comprehension

Check and service powerplant ice control systems (No manipulative skill training.)
Check and service air scoops and leading edge ice control systems
Check and service electrical windshield ice control systems
Check and service antennas, accessories and pitot static devices
Troubleshoot and repair windshield rain removal and window defogging systems
Inspect and repair air scoops and leading edge ice control systems
Inspect and repair windshield ice control systems
Check and service pneumatic windshield anti-icing and defogging systems

Level 3 - Application

Inspect and repair powerplant ice control components

WARNING SYSTEMS

Level 1 - Knowledge

Inspect and repair warning system components

Level 2 - Comprehension

Check and service hydraulic power and system components
Check and service ice and rain protection
Check and service lights and lighting
Check and service doors and emergency windows
Check and service flight controls, flaps, spoilers and leading edge devices
Check and service powerplant starting and vibration
Check and service overspeed and underspeed
Check and service electrical, pneumatic and oxygen systems

RECIPROCATING ENGINES

Level 2 - Comprehension

Inspect and repair fourteen cylinder radial engine or larger
Overhaul fourteen cylinder radial engine or larger

Level 3 - Application

Check and service fourteen cylinder radial engine or larger
Remove and install engine
Check and service cylinder
Inspect and repair gear reduction section
Inspect and repair supercharger
Operate engine
Inspect and repair four or six cylinder opposed engine
Inspect and repair seven or nine cylinder radial engine
Check and service gear reduction section
Check and service supercharger
Overhaul gear reduction section
Overhaul supercharger

Level 4 - Analysis/Synthesis

Identify types and principles of reciprocating powerplants (No manipulative skill training.)
Inspect and repair cylinder
Troubleshoot
Check and service four or six cylinder opposed engine
Check and service seven or nine cylinder radial engine
Overhaul four or six cylinder opposed engine
Overhaul seven or nine cylinder radial engine
Overhaul cylinder

TURBINE ENGINES

Level 1 - Knowledge

Overhaul turbofan
Overhaul accessories
Overhaul turboprop

Level 2 - Comprehension

Inspect and repair accessories
Check and service turbofan
Inspect and repair turbofan

Level 3 - Application

Remove and install engine
Inspect and repair turbojet
Check and service accessories
Check and service turbojet
Operate engine
Overhaul turbojet
Check and service turboprop
Inspect and repair turboprop

Level 4 - Analysis/Synthesis

Identify types and principles of turbine engines (No manipulative skill training.)
Troubleshoot

LUBRICATING SYSTEMS

Level 2 - Comprehension

Inspect and repair coolers and temperature regulators

Level 3 - Application

Identify types of lubrication systems
Identify types and specifications of lubricants
Check and service coolers and temperature regulators
Check and service pumps and valves
Check and service seals and other components
Check and service tanks and lines
Inspect and repair pumps and valves
Inspect and repair tanks and lines
Inspect and repair seals and other components
Adjust pressure
Inspect and repair oil dilution system
Check and service oil dilution system

IGNITION SYSTEMS

Level 3 - Application

Identify special dangers of high energy systems
Check and service turbine ignition systems
Check and service low tension systems
Inspect and repair turbine ignition systems
Check and service booster starting systems
Check and service high tension systems

Level 4 - Analysis/Synthesis

Inspect and repair low tension systems and components
Inspect and repair booster starting systems
Inspect and repair high tension systems and components

FUEL METERING

Level 2 - Comprehension

Inspect, maintain, and test gas turbine fuel control units
Inspect, maintain, and test ADI systems
Trim turbine powerplants

Level 3 - Application

Inspect, maintain, and test carburetor de-icing and anti-icing
Check and service water injection system
Determine causes of detonation, auto ignition, etc.
Inspect, maintain, and test float carburetors
Inspect, maintain, and test injection carburetors
Inspect, maintain, and test injection nozzles

INDUCTION SYSTEM

Level 3 - Application

Inspect and maintain carburetor intake and intake pipes
Inspect and maintain heat exchangers

PROPELLER (GENERAL)

Level 1 - Knowledge

Apply theory of balance
Identify special propeller lubricants

Level 2 - Comprehension

Apply theory of thrust
Use propeller specifications

Level 3 - Application

Perform specialized propeller inspections
Perform propeller track
Use universal protractor

FIXED PITCH PROPELLERS (WOOD)

Level 1 - Knowledge

Refinish propeller
Balance vertical and horizontal

Level 3 - Application

Remove and install

FIXED PITCH PROPELLERS (METAL)

Level 1 - Knowledge

Refinish propeller
Balance vertical and horizontal

Level 3 - Application

Repair propeller (minor)
Remove and install

TWO POSITION AND CONSTANT SPEED PROPELLERS

Level 2 - Comprehension

Disassemble and assemble per manufacturer's specifications

Level 3 - Application

Apply theory of operation (No manipulative skill training.)
Remove and install
Check operation

CONSTANT SPEED FEATHERING PROPELLERS

Level 2 - Comprehension

Disassemble and assemble per manufacturer's specifications

Level 3 - Application

Apply theory of operation
Remove and install
Check operation

REVERSIBLE PROPELLERS (RECIPROCATING ENGINES)

Level 1 - Knowledge

Disassemble and assemble per manufacturer's specifications

Level 3 - Application

Apply theory of operation
Remove and install

REVERSIBLE PROPELLERS (TURBINE ENGINES)

Level 1 - Knowledge

Disassemble and assemble per manufacturer's specifications

Level 3 - Application

Apply theory of operation
Remove and install

GOVERNORS

Level 1 - Knowledge

Disassemble and assemble per manufacturer's specifications

Level 2 - Comprehension

Bench test

Level 3 - Application

Line inspection and adjustment
Apply theory of operation
Service synchronization system
Check and service bleed valve governor

DRAFTING

Level 1 - Knowledge

Use and care of essential drafting instruments and equipment
Draw projections

Level 2 - Comprehension

Care of blueprints
Use appropriate symbols i.e., hydraulic, electrical, etc.

Level 3 - Application

Use and interpret standard blueprint information
Interpret and apply data in title block, bill of materials, etc.
Draw shop sketches

WEIGHT AND BALANCE

Level 2 - Comprehension

Prepare and weigh aircraft
Measure moment arm
Compute weight and balance
Correct for adverse conditions or effects of improper loading
Record weight and balance data
Use terminology and symbols

Level 3 - Application

Use specifications, data sheets, and aircraft listing

AIRCRAFT MATERIAL AND PROCESSES

Level 1 - Knowledge

Utilize basic economic and engineering criteria in selection of materials
Use high energy forming processes

Level 2 - Comprehension

Develop an understanding of structure and composition of metals and their alloys such as SAE steels, corrosion resistant steel, copper, nickel, aluminum, magnesium, titanium, special high temperature metals, etc.
Perform basic heat treating and annealing processes
Identify physical properties of materials
Identify mechanical properties of materials
Identify windshield and window materials

Level 3 - Application

Identify standard hardware and materials
Use the technical terminology common to materials utilized in airframes and propulsion units
Identify types of corrosion and preventive measures
Identify piping color coding
Apply principles of adhesive bonding

INSPECTION FUNDAMENTALS

Level 1 - Knowledge

Use fundamentals of statistical inspection
Use non-destructive testing, chemical etching
Use non-destructive testing, hardness
Use non-destructive testing, ultrasonic
Use non-destructive testing, radiography (X ray)
Use non-destructive testing, eddy current

Level 2 - Comprehension

Use non-destructive testing, penetrants
Use non-destructive testing, magnetic particle

Level 3 - Application

Inspect for general source of wear and deterioration
Complete typical report forms and status tags
Use manufacturer's inspection data

Level 4 - Analysis/Synthesis

Use precision measuring devices, micrometers, height gages, etc.

AIRCRAFT AND ENGINE INSPECTION

Level 2 - Comprehension

Inspect aircraft (annual)
Inspect aircraft (overhaul checks)
Use general aviation inspection aids summary

Level 3 - Application

Perform and record inspections per manufacturer's FAA or progressive requirements
Inspect aircraft (walk around)
Use inspection guides
Use manufacturer's service bulletins

GROUND SUPPORT EQUIPMENT

Level 2 - Comprehension

Use hydraulic equipment
Use pneumatic equipment
Use electrical equipment
Use fuels, lubricants and fluids
Use line starting equipment

Level 3 - Application

Use ground fire protection

GROUND HANDLING

Level 1 - Knowledge

Use tow bars and towing equipment
Spot and moor aircraft
Taxi aircraft

Level 2 - Comprehension

Use standard line and taxi signals
Fuel aircraft
Perform pre-flight servicing
Perform post-flight servicing

Level 3 - Application

Jack aircraft

CLEANING AND CORROSION CONTROL

Level 1 - Knowledge

Identify applications and limitations of soaps and detergents
Identify applications and limitations of window and windshield cleaning agents
Use interior cleaning equipment and procedures
Use carbon removers
Use cleaning equipment and procedures for electrical component cleaning
Use cleaning equipment and procedures for ultrasonic degreasing

Level 2 - Comprehension

Use cleaning equipment and procedures for vapor degreasing
Inspect and determine adequacy of cleaning performed on airplanes
Use sand, shell, grit, and vapor blasting

Level 3 - Application

Identify applications and limitations of chemical solvents and paint removers flammability and explosion characteristics
Inspect for evidence of corrosion in critical areas
Apply principles of airplane cleaning and corrosion control

MATHEMATICS

Level 1 - Knowledge

Extract roots and raise numbers to given powers
Perform descriptive geometry as applied to template development and layout
Calculate areas and volumes of various geometric shapes

Level 2 - Comprehension

Perform layouts utilizing fundamentals of geometric construction

Level 3 - Application

Read and interpret graphs and charts
Calculate ratios, proportions and percentages
Perform algebraic operations involving subtraction, addition, multiplication and division of positive and negative numbers

Level 4 - Analysis/Synthesis

Add, subtract, multiply and divide

ENGLISH

Level 4 - Analysis/Synthesis

Read, write and speak the English language
Write clear, concise, grammatically correct technical reports normally expected of certificated mechanics
Use dictionary and standard reference books
Read pertinent technical data with comprehension

PHYSICS

Level 1 - Knowledge

Perform temperature conversions, problems involving relationships of gases and pressures and mechanical equivalents of heat
Perform necessary calculations to understand effect of speed of sound, frequency, pressure, loudness, reflection of sound waves, etc.

Level 2 - Comprehension

Solve gas and fluid problems such as pressure, volume, Pascal's Law, Bernoulli's Principle, etc.

Level 3 - Application

Perform calculations involving mechanics such as levers, pulleys, inclined planes, linear motion, etc.

CHEMISTRY

Level 1 - Knowledge

Apply chemical principles to electrolysis and its effect
Apply chemical principles to basic chemistry of fuels, lubricants and hydraulic fluids
Apply chemical principles to the basic chemistry of paints, lacquers and thinners

Apply chemical principles to the chemical reactions within batteries
Apply chemical principles to the chemistry of adhesives and sealing materials
Apply chemical principles to common elements and elementary compounds such as salts, bases, and acids

AIRCRAFT NOMENCLATURE

Level 3 - Application

Use proper aircraft nomenclature
Classify aircraft as to propulsion devices, wing arrangement, purpose, landing gear systems, etc.
Apply FAA aircraft categories and definitions as found in appropriate publications such as: FAR 1, 21, 23, etc.

THEORY OF FLIGHT

Level 2 - Comprehension

Interpret theory of flight in relation to rotary wing
Interpret theory of flight in relation to rotorcraft flight controls and their effects
Interpret theory of flight in relation to thrust torque and torque correction as applied to rotorcraft

Level 3 - Application

Interpret theory of flight in relation to reference axes of aircraft
Interpret theory of flight in relation to function of conventional controls and control surfaces
Interpret theory of flight in relation to high lift devices such as flaps, slats, etc.
Interpret theory of flight in relation to properties of the earth's atmosphere
Interpret theory of flight in relation to aircraft maneuvers such as turns, skids, stalls, etc.
Interpret theory of flight in relation to forces acting on an airfoil and airplane
Interpret theory of flight in relation to unconventional controls and control surfaces
Interpret theory of flight in relation to loads and effect of turbulence and speed
Interpret theory of flight in relation to wing loading, power loading, maneuvering speed, etc.

FAR AND RELATED PUBLICATIONS

Level 1 - Knowledge

File and index publications
Use of technical standard orders (TSO) and supplemental type certificate (STC)

Level 2 - Comprehension

Use flight safety mechanics bulletins

Level 3 - Application

Use specifications, data sheets, manuals, and publications on aircraft, engines and propellers
Use required federal air regulations
Interpret and use specifications such as MS, AC, AN, NAS and typical manufacturer's manuals
Interpret and use ATA specification 100
Know how and where to find pertinent data in FAA specifications
Use of logbooks and making maintenance record entries
Use and disposition of FAA forms
Use airworthiness directives (FAR 39)

SHOP MANAGEMENT RESPONSIBILITIES

Level 1 - Knowledge

Apply FAA regulations in repair station operation
Apply shop management principles to organization and assignment of personnel
Purchase parts and supplies
Perform elementary accounting
Perform inventory control of materials, equipment

Level 2 - Comprehension

Maintain required records
Perform job estimating

ETHICS AND LEGAL RESPONSIBILITIES

Level 1 - Knowledge

Practice the legal responsibilities of bailment
Practice the legal responsibilities of mechanics liens

Level 2 - Comprehension

Employ ethical practices related to mechanic/customer relationship

Level 3 - Application

Employ ethical practices related to job and product pride and craftsmanship
Employ ethical practices related to mechanic/employer relationship
Employ ethical practices related to the responsibilities of aviation
Employ ethical practices related to personal conduct and integrity
Practice the legal responsibilities of liability of the certificated mechanic

CORE CURRICULUM DELETION LIST

On the basis of a detailed review of all subtopics, the National Advisory Committee recommended deletions from the core curriculum for the following reasons: (1) task is obsolete, (2) task is highly specialized and training is generally provided by the industry, and/or (3) task is impractical for schools to teach because of the equipment, funds, or time required.

FABRIC COVERING

Inspect and repair structure for cover
Perform power sewing

ELECTRICAL POWER

Apply battery theory and test equipment to test and service dry battery equipment

AIRCRAFT COMMUNICATIONS AND NAVIGATION EQUIPMENT

Check, troubleshoot, and replace passenger announcement and entertainment systems

IGNITION SYSTEMS

Classify types of magnetos
Check and service battery ignition systems
Inspect and repair battery ignition systems

GROUND ADJUSTABLE PROPELLERS

Remove and install propeller
Disassemble and assemble per manufacturer's specifications
Repair blades and hub (minor)
Repitch propeller
Balance propeller

TWO POSITION AND CONSTANT SPEED PROPELLERS

Balance propeller
Overhaul propeller

CONSTANT SPEED FEATHERING PROPELLERS

Balance propeller
Overhaul propeller

REVERSIBLE PROPELLERS (RECIPROCATING ENGINES)

Overhaul propeller

REVERSIBLE PROPELLERS (TURBINE ENGINES)

Overhaul propeller
Check and service turboprop engine brake

GOVERNORS

Overhaul governor

DRAFTING

Use specifications and drafting room manuals
Draw intersections and developments
Draw lines, dimensions, sections, scales, etc.
Draw technical working drawings

WEIGHT AND BALANCE

Use loading graphs, center of gravity envelopes and loading schedules
Use FAA form and CAM 18

INSPECTION FUNDAMENTALS

Use destructive testing, tension
Use destructive testing, bending
Use destructive testing, impact

AIRCRAFT AND ENGINE INSPECTION

Check storage status of non-active aircraft

GROUND SUPPORT EQUIPMENT

Drive fuel trucks
Use ground air conditioner

GROUND HANDLING

Hoist aircraft

MATHEMATICS

Perform calculations common to right triangles and use of trigonometric tables.
Perform calculations involving use of slide rule

CHEMISTRY

Apply chemical principles to chemistry of plastics, both clear and reinforced
Apply chemical principles to the composition of matter - molecules, atoms, and electrons
Apply chemical principles to the chemistry of natural and synthetic fabrics
Use chemical symbols and equations
Use periodic table

Projections

The national Study of the Aviation Mechanics Occupation has been a positive endeavor to assist the aviation mechanics schools in their training programs. The research contained in this study stands alone as a significant step in the search for new approaches for the training of aviation mechanics. Methods to maintain curriculum currency for instruction and to expand in-service training for teachers of aviation mechanics must be developed. Experimental programs implementing the suggested core curriculum and introducing new instructional materials for teachers will continue as a follow-up to this study.

With the development of the recommended core curriculum, a system for introducing up-dated information into the curriculum now becomes necessary. Such a system will require re-evaluation of each subtopic in the core curriculum at regular intervals. This can be accomplished by selected qualified representatives of the four aviation industry categories. These representatives will begin by analyzing the data in this study and make recommendations for additions and deletions to the core curriculum, as well as corrections to the technical knowledge, manipulative skill, and industry training levels.

Procedures for making these evaluations will be carefully planned and monitored to ensure the validity of their recommendations. The results will then be presented to a national advisory review board having a representation similar to that of the National Advisory Committee that assisted this study. The review board will examine the industry findings, recommend changes as needed in the core curriculum, and communicate these recommendations to the aviation mechanic schools. It is suggested that this type of review of the core curriculum be undertaken biennially.

The process described above would be educationally unproductive, however, if all attention were given the curriculum and the teachers were overlooked. A continuing program of in-service teacher training will contribute greatly to maintaining the technical currency of teachers of aviation mechanics. One means of keeping the teachers up to date will be to organize in-service teacher training workshops on a national level. Extensions of this service to other aviation mechanics instructors will augment the effectiveness of their instruction and enable them to present the most recently validated data on the essential technical and manipulative skills.

Efforts planned for the future at appropriate times include short experimental training programs using instructional materials that are designed to meet the levels of educational attainment identified in this study. These programs will include: training of selected aviation mechanic instructors in the use of instructional materials developed through the findings of this study; testing the innovated curriculum to determine the effectiveness of the specially designed instructional materials; and testing for significant differences of teaching effectiveness between instructors trained in the use of prepared materials and instructors who lack this special training.

Pilot programs for training aviation mechanics, based on the entire core curriculum, will be established at a later date. These programs will be conducted by teachers who will have been trained in the use of the new instructional materials directly applicable to the new curriculum. These pilot programs will be of sufficient duration to permit them to be evaluated by a comparison of a group of mechanics graduated from a program taught under the innovated curriculum and another group of mechanics graduated from other programs.

The goals presented herein can realistically be met and are well within the purview of all who are associated with the aviation industry. A continued cooperative interaction between the industry and the schools can significantly assist the future of aviation.

Appendices

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Appendix A

NATIONAL ADVISORY COMMITTEE

The National Advisory Committee is comprised of the following members:

B. B. Ashlock . . . . Training Director, Airwork Corporation Millville, New Jersey

N. Birta . . . . Principal, Aero Mechanics High School Detroit, Michigan

J. E. Christopher . . . . . . General Aviation Specialist, Flight Standards Division, Federal Aviation Agency, Fort Worth, Texas

B. C. Draper* . . . . Supervisor of Training, United Air Lines, Los Angeles International Airport Los Angeles, California

A. W. Elwell . . . . Supervisory Examination Specialist, Maintenance Technical Standards Branch, Federal Aviation Agency Aeronautical Center, Oklahoma City, Oklahoma

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*Mr. Draper attended the second meeting of the National Advisory Committee at Purdue University, April 12-13, 1966, as a special advisory member in the area of aviation electronics.

J. M. Fisher	Vice-President, Pittsburgh Institute of Aeronautics, Pittsburgh, Pennsylvania
C. B. Gregg	Director, Technical Training and Qualifications, American Airlines, Maintenance and Engineering Center, Tulsa, Oklahoma
R. H. Madeira	President, Page Aircraft Maintenance, Inc., Dothan, Alabama
H. A. Palmer	Service Manager, Vroman Aviation, Inc., Midland, Texas
H. B. Pickering	Chief, Airmen and Schools Group, Maintenance Division, Federal Aviation Agency, Washington, D.C.
H. Rosen	Assistant Director of Research, Office of Research, United States Department of Labor, Washington, D.C.
C. W. Schaffer	Principal Maintenance Inspector, Federal Aviation Agency, General Aviation District Office, Allegheny County Airport, West Mifflin, Pennsylvania

Appendix A

J. J. Tordoff . . . . Manager of Personnel Management, United Air Lines, San Francisco International Airport, San Francisco, California

A. Vai . . . . Director of Aviation Maintenance Training, Northrop Institute of Technology, Inglewood, California

E. G. Willis . . . . Chairman, Southern Region Repair Station Advisory Council, Jacksonville, Florida

F. Woehr . . . . Principal, Aviation High School, Long Island City, New York

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Appendix B

RESEARCH SURVEY ANALYSTS

The six research survey analysts and their respective areas of responsibility for conducting the national survey are listed here.

AREA I

Washington, Oregon, Utah, and Idaho	James W. Carlson Pullman, Washington

Mr. Carlson attended Washington State University where he majored in civil engineering, with additional study in advanced Air Force ROTC His experience includes ownership and operation of a construction contracting firm in Pullman, Washington.

AREA II

Texas, Oklahoma, Kansas, Colorado, and western Missouri	Stanley L. Moore Norman, Oklahoma

Mr. Moore received his degree in civil engineering from the University of Oklahoma where he was an assistant professor of engineering for many years.

AREA III

Minnesota, Iowa, Illinois, and eastern Missouri	William J. Schill Champaign, Illinois

Dr. Schill received his doctorate from the University of California, Los Angeles, and is now associated with the Department of Vocational and Technical Education, University of Illinois.

AREA IV

North Carolina, South Carolina, Georgia, and Florida — Capt. Ira W. Brown, USN (ret.), Virginia Beach, Virginia

Capt. Brown has an extensive background in military aviation as a pilot and in aircraft testing and aircraft maintenance engineering.

AREA V

Maryland, Michigan, Ohio, Pennsylvania, and Washington, D.C. — Cdr. John N. White, USN (ret.), Hillcrest Heights, Maryland

Cdr. White is an experienced military pilot who has been associated with aircraft operational and maintenance activities for 22 years.

AREA VI

New Jersey, Massachusetts, New York, and Connecticut — Lcdr. Roger M. Turner, USN (ret.), Virginia Beach, Virginia

Lcdr. Turner has had more than 30 years experience in aviation maintenance as a mechanic and as a supervisor and director of military maintenance activities.

Appendix C

RESPONDING COMPANIES

CALIFORNIA

Bakersfield

Buchner's Flying Service
Meadows Field

Del's Air Service
Minter Field

Inland Crop Dusters, Inc.
Minter Field

Vern's Wing Shop
Minter Field

Burbank

Comet Copters
Lockheed Air Terminal

Monark Flight Service
Lockheed Air Terminal

Pacific Airmotive Corp.
Lockheed Air Terminal

Potter Aircraft Service, Inc.
Lockheed Air Terminal

Qualitron Aero, Inc.
Lockheed Air Terminal

Richfield Oil Co.
Lockheed Air Terminal

Sky Roamers Air Travel, Inc.
Lockheed Air Terminal

Chico

Chico Aviation Service
Chico Municipal Airport

Chico (continued)

Al Sos Aviation
Rt. 3, Box 464 Chico Ranchero

Clarksburg

Air Repair
Borges-Clarksburg Airport

Fresno

Air-Oasis Co.
Chandler Municipal Airport

Howard Winters Co.
Fresno Air Terminal

Norsigian Bros.
Fresno Air Terminal

Skyway Service
Chandler Municipal Airport

Glendale

Grand Central Aircraft Co.
Box 3157

Hagelin Aircraft Motors, Inc.
933 Air Way Drive

Hawthorne

Progressive Air Service, Inc.
Hawthorne Airport

Bates Aviation, Inc.
Hawthorne Airport

CALIFORNIA (continued)

Long Beach

Aircraft Associates
Long Beach Airport

Air Oasis Co.
Long Beach Airport

Aztec Aircraft Sales, Inc.
Long Beach Airport

Beach-Air, Inc.
Long Beach Airport

Belmont Aviation Corp.
Long Beach Airport

Scott Aero Services, Inc.
Long Beach Airport

Los Angeles

AiResearch Aviation Service Co.
Los Angeles International Airport

American Airlines
Los Angeles International Airport

Continental Air Lines, Inc.
Los Angeles International Airport

Pan American World Airways
Los Angeles International Airport

Trans World Airlines
Los Angeles International Airport

United Air Lines
Los Angeles International Airport

Western Air Lines
Los Angeles International Airport

Modesto

Pacific Aircraft Service
Modesto City-County Airport

Oakland

California Aviation Service, Inc.
Oakland International Airport

Golden Gate Aviation, Inc.
Oakland International Airport

World Airways
Oakland International Airport

Ontario

Aerojet General Flight Operations
Ontario International Airport

Zantop Air Transport
Ontario International Airport

Pacoima

Volitan Aviation, Inc.
Pacoima Airport

W. H. Coffin Air Service, Inc.
Pacoima Airport

Palo Alto

Hiller Aircraft Co.
Palo Alto

Oceanside

Palomar Aviation
Palomar Airport

Pomona

Brackett Field Aircraft Service
Brackett Field

Northside Aircraft Maintenance
Brackett Field

CALIFORNIA (continued)

Rio Vista

Westare Service
P. O. Box 745

Riverside

Air Oasis Co.
Riverside

Sacramento

Capitol Sky Park, Inc.
Sacramento Municipal Airport

Cartwright Aerial Surveys, Inc.
Sacramento Municipal Airport

Jensen Field
Sacramento

Patterson Aircraft Co.
Sacramento Municipal Airport

Rotorcraft Industries, Inc.
Sacramento Municipal Airport

State of California
Department of Fish and Game
Sacramento Municipal Airport

San Carlos

Custom-Air
San Carlos Airport

San Diego

Air Oasis Co.
Lindbergh Field

Carson Airplane Service
Santee

Pacific Southwest Airlines
3100 Goddard Way

San Diego (continued)

Spider's Aircraft Service
Montgomery Field

San Fernando

Deb's Aircraft and Engine Service
1065 Arroyo

Ryan Air Service
San Fernando

San Francisco

Butler Aviation-San Francisco, Inc.
San Francisco International Airport

Flying Tiger Line, Inc.
San Francisco International Airport

Pacific Air Lines
San Francisco International Airport

Pan American World Airways
San Francisco International Airport

Rick Helicopters, Inc.
San Francisco International Airport

Slick Airways, Inc.
San Francisco International Airport

United Air Lines
Maintenance Base
Line Service Center
San Francisco International Airport

San Jose

FMC Corporation
San Jose

Gee Bee Aero
San Jose

Lockheed Aircraft Service Company
San Jose Municipal Airport

CALIFORNIA (continued)

San Jose (continued)

San Jose Aircraft Service
San Jose Municipal Airport

Wright Brothers, Inc.
San Jose Municipal Airport

San Mateo

Nystrom Aviation, Inc.
San Mateo County Airport

Santa Monica

Bacon Aircraft Co.
Santa Monica Airport

Conard Aviation Services
Santa Monica Airport

Gunnell Aviation, Inc.
Santa Monica Airport

Mox-Air
Santa Monica Airport

Santa Monica Aviation, Inc.
Santa Monica Airport

Santa Monica Flyers
Santa Monica Airport

Stockton

Bridgeford Flying Service
Stockton Metropolitan Airport

Werner's Aero Service
Stockton Metropolitan Airport

Torrance

Acme Aircraft Co.
Torrance Airport

Mercury General American Corporation
Torrance

Nagle Aircraft Sales, Inc.
Torrance

Tulare

Johnston Aircraft Service
Tulare Air Park

Tulare Aircraft Service
Tulare Air Park

Van Nuys

Air Travelers, Inc.
Van Nuys Airport

Great Western Aviation of Van Nuys
Van Nuys Airport

Planeservice, Inc.
Van Nuys Airport

Valley Pilots Flying Service
Van Nuys Airport

COLORADO

Aurora

Skyranch Aviation
Skyranch Airport - P. O. Box 458

Broomfield

Kensair Corporation
Jefferson County Airport

Colorado Springs

Beeline Aviation, Inc.
Peterson Field - P. O. Box 7885

Denver

Aircraft Radio & Accessory Company, Inc.
Stapleton Airfield

Combs Aircraft, Inc.
Stapleton Airfield, Hangar #7

Continental Airlines, Inc.
Stapleton Airfield

Denver (continued)

Frontier Airlines, Inc.
Stapleton Airfield

United Airlines, Inc.
Stapleton Airfield

Western Air Lines, Inc.
Stapleton Airfield, Hangar #4

La Junta

Todd Flying Service
P. O. Box 605

Pueblo

Pueblo Aircraft Service
Airport Box 149

CONNECTICUT

New Haven

NHA Radio and Maintenance
Tweed New Haven Airport

New London

Pilgrim Aviation & Airlines, Inc.
Box 1743

Windsor Locks

Air Kaman, Inc.
Bradley Field

DELAWARE

Wilmington

Atlantic Aviation Corporation
Wilmington Division

WASHINGTON, D. C.

American Airlines, Inc.
Washington National Airport

Delta Air Lines, Inc.
Washington National Airport

Northwest Air Lines
Washington National Airport

Piedmont Airlines
Washington National Airport

Trans World Airlines, Inc.
Washington National Airport

United Air Lines, Inc.
Washington National Airport

FLORIDA

Daytona Beach

Embry-Riddle Aeronautical Institute
P. O. Box 2411

Fort Lauderdale

Mackey Airlines, Inc.
International Airport
500 S. W. 34th Street

Riley Aeronautics Corporation
2100 N. W. 50th Street
Fort Lauderdale Executive Airport

Jacksonville

East Coast Flying Service
Imeson Field

Miami

Aero Facilities Corporation
P. O. Box 245

Airtech Service, Inc.
International Airport
P. O. Box 48-516

American Airmotive Corporation
International Airport

Eastern Air Lines, Inc.
Miami International Airport

Miami (continued)

National Airlines, Inc.
P. O. Box 2055
Airport Mail Facility

Pan American World Airways
36th Street

Southern Air Transport, Inc.
International Airport
P. O. Box 48-1266

Opa Locka

Dumod Corporation
Opa Locka Airport
P. O. Box 425

Engine Air, Inc.
Building 147
Wright Road, Opa Locka Airport

Tursair Executive Aircraft, Inc.
Hangar #101, Opa Locka Airport
P. O. Box 85

Orlando

Showalter Flying Service, Inc.
Municipal Airport

Southern Airways of Florida
Municipal Airport
P. O. Box 20174

FLORIDA (continued)

Sebring

Eighth Air Depot, Inc.
Sebring Air Terminal

Tampa

Aircraft Propeller, Inc.
4021 W. Cayuga Street

West Palm Beach

Butler Aviation
Hangar #475, Duncan Avenue
International Airport

GEORGIA

Atlanta

Delta Air Lines, Inc.
Atlanta Airport

Southern Airways Company
Atlanta Airport

Atlanta (continued)

United Air Lines, Inc.
Atlanta Airport

Macon

Associated Airmotive, Inc.
Municipal Airport, Cochran Field

IDAHO

Boise

Aircraft Service & Repair Company
2410 Sunrise Rim Road

Morrison-Knudsen Company, Inc.
Aviation Department
Gowen Field - P. O. Box 7808

Sparks Flying Service
Municipal Airport

Burley

Magic Valley Aviation
Box 824

Idaho Falls

Idaho Aviation Center, Inc.
Box 498

Lewiston

Hillcrest Aircraft Company
Box 405

Nampa

Clarks Flying Service
Box 56

Twin Falls

Reeder Flying Service
Municipal Airport

ILLINOIS

Chicago

Helicopter Air Lift, Inc.
5245 W. 55th Street

Trans World Airlines, Inc.
O'Hare International Airport
P. O. Box 8787

United Airlines
Elk Grove Village

Crystal Lake

Executive Aircraft Maintenance Corp.
Crystal Lake Airport

East Alton

Walston Aviation, Inc.
Civic Memorial Airport

East St. Louis

Parks College of Aeronautical Technology
of St. Louis University
Parks Airport

Elgin

B & M Aircraft Corporation
Elgin Airport

Midlothian

Howell Flying Service
13202 S. Circus

Northbrook

Aircraft Propeller Sales & Service
Sky Harbor Airport

Prairie View

Whirlwind Propeller Service, Inc.
Chicagoland Airport
Box 246-A

Rockford

Hartzog-Schneck Aviation, Inc.
Greater Rockford Airport

Sundstrand Aviation
Division-Sundstrand Corporation
2421 11th Street

Woodward Governor Company
5001 N. Second Street

Springfield

Capitol Aviation, Inc.
Capital Airport

IOWA

Des Moines

Des Moines Flying Service, Inc.
Municipal Airport

KANSAS

Dodge City

Mahon's Boot Hill Flying Service
Municipal Airport - Box 194

Kansas City

Aircraft and Industrial Services
3041 Fairfax Road

Topeka Aircraft Sales and Service
3251 Fairfax Road
Fairfax Airport

Wichita

Beech Aircraft Corporation
9709 E. Central

Wichita (continued)

Lear Jet Corporation
Municipal Airport
Box 28

Midwest Piper Sales, Inc.
Box 2667
Munger Station

Standard Precision, Inc.
Div. of E.C.I., St. Petersburg, Fla.
4105 W. Pawnee

United Airplane Sales, Inc.
Municipal Airport

Yingling Aircraft, Inc.
P. O. Box 1162
Municipal Airport

MARYLAND

Baltimore

Bendix Corporation
Friendship International Airport

Butler Aviation, Inc.
Friendship International Airport

Chesapeake & Potomac Airway
Friendship International Airport

Baltimore (continued)

Delta Airlines, Inc.
Friendship International Airport

Marshall-Air
Friendship International Airport
2300 Dorsey Road

Pan American World Airways
Friendship International Airport

MASSACHUSETTS

Beverly

Revere Aviation, Inc.
Beverly Airport

Boston

Northeast Airlines, Inc.
Logan International Airport

MASSACHUSETTS (continued)

East Boston

Butler Aviation-Boston Inc.
Logan Airport

Great Barrington

Berkshire Aviation Enterprises, Inc.

Mansfield

Carleton-Whitney Aero Service, Inc.
Municipal Airport

North Adams

Mohawk Valley Aviation Company, Inc.
Harriman Airport

Worcester

Atlantic Aviation
Municipal Airport

MICHIGAN

Adrian

Prentice Aircraft, Inc.
Adrian City Airport

Detroit

Helicopter Airways Service, Inc.
Metropolitan Airport

Freeland

Air-Flite & Serv-A-Plane, Inc.
Tri-City Airport

Grand Rapids

Northern Air Service, Inc.
Kent County Airport

Inkster

American Airlines, Inc.
Detroit-Metropolitan Airport

Pontiac

Aerodynamics, Inc.
Municipal Airport

Michigan Aviation Company
6150 Highland Road
Municipal Airport

Sparta

Sparta Aviation Service
Sparta Airport

Three Rivers

Ward Aero, Inc.
Haines Airport
Box 219

Ypsilanti

United Air Lines, Inc.
Willow Run Airport

MINNESOTA

Minneapolis

Minnesota Airmotive
Division-F. H. Peavey & Company
Wold-Chamberlain Field

Northwest Airlines, Inc.
Minneapolis-St. Paul International Airport

St. Paul

Minnesota Mining & Mfg. Company
Aviation Department
South Riverside Hangar
Downtown Airport, Holman Field

MISSOURI

Kansas City

Executive Aircraft Company
Municipal Airport

Kansas City Flying Service &
Air College, Inc.
601 Lou Holland Drive

Trans World Airlines, Inc.
Mid-Continent International Airport

Perryville

Beldex Corporation
Division of Remmert-Werner
Chester-Perryville Airport

St. Louis

Interstate Airmotive, Inc.
Lambert Field

Ozark Air Lines, Inc.
Lambert Field

NEW JERSEY

Linden

MATCO, Corporation
Linden Airport

Millville

Airwork Corporation
Municipal Airport

Morristown

Continental Can Company, Inc.
Air Transport Department
Box 791

Newark

Newark Air Service, Inc.
Hangar #12 - Newark Airport

Newton

The Aeroflex Corporation
Aeroflex-Andover Field
Rd. #1, Box 411

South Hackensack

National Distillers & Chemical Corp.
Air Transport Division, RS 1166

Teterboro

Teterboro Aircraft Service
Teterboro Airport
401 Industrial Avenue

Atlantic Aviation Corporation
Teterboro Airport

NEW YORK

Albany

New York State Conservation Department
Aviation Division
Albany County Airport

Binghamton

Broome County Aviation, Inc.
Box 904
Broome County Airport

Buffalo

Buffalo Aeronautical Corporation
Buffalo Airport

Buffalo Air-Park, Inc.
4500 Clinton Street

Elmira

Schweizer Aircraft Corporation
Chemung County Airport
P. O. Box 147

Flushing

American Airlines, Inc.
LaGuardia International Airport

Butler Aviation-LaGuardia
Hangar #7 - LaGuardia Airport

New York Airways, Inc.
LaGuardia Airport - P. O. Box 426

Speed's Flying Service, Inc.
23-11 Linden Street
Flushing Airport

Horseheads

Elmira Aeronautical Corporation
3330 Sing Sing Road

Jamaica

Lockheed Aircraft Service Company
A Division-Lockheed Corporation
John F. Kennedy International Airport

Pan American World Airways
John F. Kennedy International Airport

Seaboard World Airlines, Inc.
John F. Kennedy International Airport

Trans World Airlines, Inc.
John F. Kennedy International Airport

Lawrence L. I.

Airengines, Inc.
25 Buena Vista Avenue

Mattituck

Mattituck Airbase, Inc.
Mattituck Airport

Rochester

Eastman Kodak Company
1705 Scottsville Road

Page Airways, Inc.
Rochester Airport - Box 1132

Ronkonkoma

Aero Trades, Inc.
MacArthur Airport

Long Island Airways, Inc.
MacArthur Airport - Box 248

Syracuse

Flight Maintenance Inc.
Hancock Airport

NEW YORK (continued)

Syracuse (continued)

Franklin Engine Company, Inc.
Liverpool Road

Utica

Mohawk Airlines, Inc.
Oneida County Airport

White Plains

American Can Company
Hangar E, Westchester County Airport

White Plains (continued)

General Electric
Air Transport Operation
Hangar E, Westchester County Airport

Johns-Manville Corporation
Westchester County Airport

Union Carbide Corporation
Aviation Department, Hangar D, Bay 2
Westchester County Airport

NORTH CAROLINA

Charlotte

Cannon Aircraft Sales & Service, Inc.
Douglas Municipal Airport - Box 968

Charlotte Aircraft Engineering, Inc.
Delta Air Base - P. O. Box 9127

Morrisville

Raleigh-Durham Aviation, Inc.
Raleigh-Durham Airport - Box 200

Winston-Salem

Piedmont Aviation, Inc.
Smith Reynolds Airport

OHIO

Cincinnati

American Airlines, Inc.
Greater Cincinnati Airport

Cincinnati Aircraft, Inc.
Hangar #2 - Lunken Airport

T. W. Smith Aircraft, Inc.
Blue Ash Airport
4490 Cooper Road

Cleveland

Aircraft Service, Inc
Cleveland-Hopkins Airport Hangar #N-9

Cleveland (continued)

American Airlines, Inc.
Cleveland-Hopkins Airport

General Airmotive Corporation
Cleveland-Hopkins Airport

Sundorph Aeronautical Corporation
Cleveland-Hopkins Airport

United Air Lines, Inc.
Cleveland-Hopkins Airport

Columbus

Clydesdale Aircraft Corporation
3850 E. Fifth Avenue

OHIO (continued)

Columbus (continued)

Executive Jet Aviation
Port Columbus Airport

Lane Aviation Corporation
Port Columbus Municipal Airport
Lane Memorial Hangar

Defiance

Zelair Corporation
Box 462
Bryan-Defiance Memorial Airport

Findlay

Aircraft Maintenance Supply
Marathon Oil Company
Aviation Division, Findlay Airport

Mansfield

Richland Aviation, Inc.
Municipal Airport

New Philadelphia

Tuscarawas County Aviation, Inc.
Municipal Airport
1834 E. High Ext.

Swanton

National Flight Service, Inc.
R. R. #4, Box 302

Toledo

Continental Aviation & Engineering Corp.
1330 Laskey Road

Vandalia

Ohio Aviation Company
P. O. Box 398

Skyways, Inc.
Dayton Municipal Airport - Box 175

West Carrollton

Southern Ohio Aviation
P. O. Box 97

OKLAHOMA

Ardmore

American Flyers, Inc.
Ardmore Industrial Air Park

Bethany

Aero-Commander
Division Rockwell Standard Corporation

Aircraft Engine Service, Inc.
5414 N. Rockwell Avenue

Bethany (continued)

United Airplane Sales of Oklahoma, Inc.
Wiley Post Airport
Hangar # 4

Duncan

Haliburton Company

OKLAHOMA (continued)

El Reno

El Reno Aviation, Inc.
Municipal Airport
P. O. Box 760

Oklahoma City

Aircraftsmen, Inc.
Will Rogers Field
P. O. Box 82516

Catlin Aviation Company
Will Rogers Field
P. O. Box 82398

Tulsa

American Airlines, Inc.
Maintenance & Engineering Center
Municipal Airport

Spartan Aircraft Company
Aviation Service Division
Municipal Airport

Yukon

Page Airmotive, Inc.
Cimarron Field
P. O. Box 12099

OREGON

Albany

Flyways, Inc.
3520 Knox Butte Road

Corvallis

Corvallis Aero Service, Inc.
Box 531

Hillsboro

Hillsboro Aviation
26225 N. W. Cornell Road

Inman Aviation, Inc.
1105 S. E. 36th Avenue
P. O. Box 66

Pendleton

Pendleton Airmotive, Inc.
Municipal Airport
Box 623

Portland

Flightcraft, Inc.
7505 N. E. Airport Way

Pan American World Airways
Portland International Airport

United Air Lines, Inc.
7000 N. E. Airport Way

Salem

Salem Aviation Inc.
3450 25th Street S. E.

Troutdale

Western Skyways, Inc.
Portland-Troutdale Airport

PENNSYLVANIA

Allentown

Reading Aviation Service, Inc.
A. B. E. Airport

Bethlehem

Bethlehem Steel Company
Aviation Services
A. B. E. Airport

Butler

Scholter Aviation Company, Inc.
475 Airport Road

Clarks Summit

Scranton Airways
Municipal Airport
Rd. # 1

Connellsville

The Lance Call Company, Inc.
Connellsville Airport
P. O. Box 754

Dravosburg

Beckett Aviation Flight Training
Allegheny County Airport

Gulf Oil Corporation
Allegheny County Airport

Erie

Erie Airways, Inc.
Port Erie Airport

Harrisburg

Lear Siegler Services, Inc.
Eastern Service Facility
6700 Allentown Boulevard

Kutztown

Kutztown Aviation Service, Inc.
Kutztown Airport

Lancaster

Sensenich Corporation
Box 1168

Latrobe

Latrobe Aviation, Inc.
Tri-City Municipal Airport
P. O. Box 150

Martinsburg

Penn-Air Inc.
P. O. Box 368

New Cumberland

L. B. Smith Aircraft Corp. of
Pennsylvania
Box 264
Har-York State Airport

Philadelphia

Aero Service Corporation
4219 Van Kirk Street

Atlantic Aviation Service, Inc.
P. O. Box 5138
International Airport

Delaware Aviation Inc.
North Philadelphia Airport

United Air Lines, Inc.
Philadelphia International Airport

Wings Inc.
Wings Field

PENNSYLVANIA (continued)

Pittsburgh

Alcoa Corporation of America
Allegheny County Airport

United Air Lines, Inc.
Greater Pittsburgh Airport
Terminal Building

Reading

Reading Aviation Service, Inc.
Box 1201
Municipal Airport

Renfrew

Defoggi Aviation Service
Rd. #1

Washington

Tri-State Aviation, Inc.
P. O. Box 238

West Mifflin

Air Exec. Inc.
Allegheny County Airport

National Steel Corporation
Allegheny County Airport

Williamsport

Lycoming Division-Avco Corporation
652 Oliver Street

Willow Grove

Kellett Aircraft Corporation
Box 35

SOUTH CAROLINA

Charleston

Hawthorne Aviation
Municipal Airport
P. O. Box 10005

Greenville

Brannon's Aero Service, Inc.
Box 871

Greer

Stevens Aviation, Inc.
Greenville-Spartanburg Airport
P. O. Box 589

West Columbia

H & H Aviation
P. O. Box 348

TEXAS

Abilene

Flite Maintenance
Rt. #2, Box 508

Addison

Brown Aero Corporation
P. O. Box 8

TEXAS (continued)

Arlington

Greater Arlington Airways
P. O. Box 1308
Arlington Municipal Airport

Austin

Browning Aerial Service
P. O. Box 609

Ragsdale Aviation, Inc.
1801 East 51st Street

Big Spring

Big Spring Aero Repair
Route #1, Box 144C

Dallas

Aerodyne Engineering Corporation
3300 Love Field Drive

Aero-Systems, Inc.
P. O. Box 20478

American Airlines, Inc.
Love Field

Braniff Airways, Inc.
Love Field

Dallas Aero Service, Inc.
3300 Love Field Drive
P. O. Box 35505

Delta Air Lines, Inc.
7201 Lemmon Avenue
Love Field

Executive Aircraft Service, Inc.
Redbird Airport

Modern Aero Sales, Inc.
Redbird Airport

Dallas (continued)

Mustang Aviation, Inc.
6911 Lemmon Avenue
Love Field

Southwest Airmotive Company
8800 Lemmon Avenue

Trans-Texas Airways, Inc.
Love Field

Fort Worth

Aircraft & Airport Services, Inc.
Greater Southwest Int'l. Airport

Broadie's Aircraft & Engine Service
Meacham Field

Central Airlines, Inc.
Greater Southwest Int'l. Airport

Continental Copters, Inc.
Box 13284

Helix Air Transports, Inc.
Division of M. H. Spinks
Enterprises, Inc.
P. O. Box 11099

Inter-American Modification Center
Meacham Field

Worth Aeronautics
Meacham Field

Houston

Air Center Maintenance
7700 Airport Blvd.

Aircraft Engines, Inc.
9041 Wingtip

Continental Oil Company
Aviation Department
8915 Randolph Road

TEXAS (continued)

Houston (continued)

Cruse Aviation, Inc.
8501 Telephone Road

Hinkle Aircraft, Inc.
International Airport
8450 Lockheed

Houston Beechcraft, Inc.
9011 Randolph Road

Charles A. Morse Company
International Airport
9046 Randolph

Precision Aeromotive Corporation
International Airport

The Superior Oil Company
8901 Telephone Road

Trans-Texas Airways, Inc.
International Airport
P. O. Box 60188

Lubbock

Aero Communications
Rt. #3, Box 201-D

Horton Aero Service
915 Kent

Lubbock Beechcraft, Inc.
Rt. #3, Box 194P

Midland

Vroman Aviation, Inc.
P. O. Box 6257

San Antonio

All American Maintenance Inc.
9103 Wetmore Road

Business Aircraft Corporation
447 W. Terminal Drive
International Airport

Chrome Plate, Inc.
9503 Middlex

Gen-Aero Inc.
260 E. Terminal Drive
International Airport
Box 16217

Nayak Aviation Corporation
206 E. Terminal Drive

San Antonio Propeller Service
130 S. Terminal Drive
International Airport

Tex-Sun Beechcraft South, Inc.
International Airport
P. O. Box 16248

Reuben E. Weiss
Hangar #8
South Terminal Drive
International Airport

Waco

Waco Aviation
Rt. #10
Box 173T

UTAH

Ogden

Southwestern Skyways, Inc. of Utah
3909 Airport Road

Salt Lake City

Thompson Flying Service of Salt Lake
Airport #1

WASHINGTON

Everett

Precision Air-Motive, Inc.
P. O. Box 2127

Thunderbird Aero Enterprises, Inc.
Snohomish County Airport

Willard Flying Service
P. O. Box 172
Paine Field

Gig Harbor

TideAir, Inc.
Rt. #2, Box 2194B
Tacoma International Airport

Issaquah

John M. Gallagher
237 Maple Lane

Kelso

Davis Air Service, Inc.
2222 South Pacific

Kent

Crest Aero
Rt. #1, Box 811

Olympia

Capital Airways
Rt. #5, Box 63

Renton

The Boeing Company
Transport Division
Box 707

Renton (continued)

Shupe Flying Service
P. O. Box 3355
Municipal Airport

Richland

Richland Flying Service Inc.
P. O. Box 611

Seattle

Aero Copters, Inc.
8333 Perimeter Road
Boeing Field

Alaska Airlines, Inc.
Seattle-Tacoma Int'l. Airport

Pacific Airmotive Corporation
Seattle Branch
7097 Perimeter Road

Pacific Northern Air Lines, Inc.
Seattle-Tacoma Int'l. Airport

State of Washington
Department of Natural Resources
20234 7th Place South

United Air Lines, Inc.
Seattle-Tacoma Int'l. Airport

Washington Aircraft & Transport Corp.
7170 Perimeter Road South
Boeing Field

West Coast Airlines, Inc.
Boeing Field

Spokane

Mamer-Shreck Air Transport
Box 272
Parkwater Station

WASHINGTON (continued)

Spokane (continued)

Mifflin Aircraft
E. 6507 Rutter
Felts Field

Price Piper, Inc.
E. 5829 Rutter Avenue
Felts Field

Walla Walla

Blue Mountain Aviation & Dusting Corp.
Rt. #4
City County Airport

Wenatchee

WenAirCo.
Aircraft Service
Box 1160

Yakima

Helicopter Service
2108 W. Washington Avenue
Yakima Airport

Noland-Decoto Flying Service, Inc.
Box 431
Municipal Airport

Northwest Air Power
2108 W. Washington
Yakima Airport

By their request, the names of four additional companies are not listed here.

Responding airline companies having both overhaul and line facilities at the same station are listed only once in Appendix C. However, the statistics for the overhaul and line facilities for such companies are shown separately in Figs. 2 and 3 in the "Action" section of the report.