

~~CONFIDENTIAL~~  
C - O - N - F - I - D - E - N - T - I - A - L

BUREAU OF AIR COMMERCE  
SAFETY AND PLANNING DIVISION

NOTE NO. 4

SURVEY OF STUDY AND DEVELOPMENT NEEDS  
OF THE AVIATION INDUSTRY

December - 1937

## SUMMARY

Prior to laying out in specific detail its program of long-range planning, study and coordination of aeronautical development, the Safety and Planning Division canvassed all available aviation agencies and persons in responsible aviation positions in an effort to determine the industry's estimate of its needs. The responses to this survey contain well over a hundred projects which the industry feels should be worked on in the interests of greater safety in aviation. These recommendations have been separated in accordance with the functional organization of the Division, have been tabulated in approximate order of their urgency or importance, and are herein presented, together with a detailed estimate of the amount of money which this Division would be required to spend between now and July 1, 1939, if these projects are to be undertaken.

## INTRODUCTION

The Safety and Planning Division of the Bureau of Air Commerce was created in July, 1937, for the general purpose of studying trends in the aviation industry, sponsoring certain types of investigation and development, and on the basis of this work, guiding the industry and the Bureau in a long-range program looking to increased usefulness and safety in aviation.

The early stages of the life of this Division were, of course, devoted to developing the organization, obtaining suitable personnel, establishing general policies and taking suitable action with reference to those activities which were carried over from the old organization. During this period two major decisions were made with reference to

general policy. The first of these was that in view of the limited amount of money available for this work, it would be advisable to confine the efforts of the Division insofar as possible to increasing the safety of aviation. This makes it necessary to forego, for the present, most of the valuable work which might otherwise be done toward fostering and developing the industry along lines other than direct safety contributions.

The second major policy, and the one upon which this report is based, was to permit the industry itself to have as large a voice as possible in deciding upon the problems toward the solution of which the efforts of this Division should be expended. With this in mind, the Division, in October, 1937, circularized the entire industry, including all aviation organizations and agencies, governmental or otherwise, and invited recommendations as to the needs of the industry with reference to safety studies or experimental development.

#### RESULTS

The response to our request for recommendations was immediate and it is felt that the results obtained as a whole give a fairly reasonable indication of the present needs of the aviation industry for increased safety. These recommendations were assigned to the proper sections, given careful preliminary study and placed on the project lists, along with those already being carried, in the order in which we feel that they might logically be undertaken. The complete lists are attached hereto.

Some of the original projects are naturally superseded by new ones in importance. In this connection it is planned to keep the organization sufficiently flexible to permit new developments or more urgent problems which may arise from time to time to be added to the project lists and undertaken in a manner consistent with their importance or with their likelihood of an early solution.

It is expected that a few of the problems listed will be dropped upon further investigation as being either unnecessary or incapable of an effective solution at this time.

A preliminary investigation is at least necessary even in those cases and it is felt that if it is at all possible, from the standpoint of time and money, work on all the projects listed should be undertaken. Only by conducting a well-rounded and thorough program can the Safety and Planning Division render much needed service in the field of increased safety.

Since the nature of aviation development is such that new problems arise daily, an amount of money over and above the estimated total cost of proposed projects must be available. The Division feels that a ten per cent reserve for this purpose is a very low estimate even if complemented by funds transferred from lapsed projects. An additional sum of twenty per cent of the net total is estimated as being required for the advisory services which are a necessary function of any service division of this nature. These items are shown in the following charts.

Attention is invited to the summary table which appears at the back of this note. This summary shows that an appropriation of

\$1,903,152.20 would be necessary for this Division for the fiscal year 1938 to 1939 if we undertook the entire job which has been indicated as necessary by the best informed sources we can find. Since this appears to be impossible it will obviously be necessary for us to fit the program of work to whatever funds are made available and seek to accomplish the maximum possible results therewith.

In studying these lists of recommended projects it should be borne in mind that the purpose of the Division is not to conduct development work, other than planning studies, with its own personnel but to instigate, encourage, direct and coordinate such work in available agencies and to test and determine the merits of the results thereof.

#### CONCLUSIONS

The following conclusions are apparent from the results of this survey:

1. The industry is urgently in need of assistance which can only be rendered by a Governmental agency such as this Division.

2. Even though the projects listed herein are only those which are felt by responsible officials to be urgently needed, their total is far beyond the financial capacity of this Division to handle, making it necessary for us to choose for our program the most important ones which hold some promise of a satisfactory solution.

3. In all of its endeavors in this connection it is apparent that the Division will have the full cooperation of practically all of the aviation agencies and manufacturers throughout the country.

4. Unless the budget for this Division is expanded beyond present indications, there will be practically no facilities available for badly needed studies of certain aspects of the existing regulations or for equally urgent fostering and development work directed toward expansion of the industry rather than specifically toward safety.

## AIRCRAFT SECTION

Item	Cost	Item	Cost
1. FOG DISSIPATION - Study of Army, Navy, and Commerce agreement with reference to the development of a fog dissipating device at Massachusetts Institute of Technology and a report as to further Commerce participation. This study has been completed and the contract with the Massachusetts Institute of Technology has been terminated.	\$50.00	18. TRICYCLE LANDING GEAR - Study of all available data and the determination, by means of a test program, of the loads on the tricycle type landing gear, the landing qualities of this type of gear, and the desirable shock-absorption characteristics and design features of this type of gear. Recommendations as to airworthiness regulations having to do with the tricycle type landing gear.	\$9,000.00
2. TELETYPE RECORDING TIME STAMP - Assistance in the development of a time stamp to definitely establish the time of every teletype message. This development has been completed and contract specifications for a Teletype Recording Time Stamp have been prepared for the Communications Section.	120.00	19. MONOCOQUE DESIGN - Compilation of all available data on monocoque design, in cooperation with A-M-C Committee and National Advisory Committee for Aeronautics. Development of a general monocoque theory such that reasonably accurate analysis of any such structure can be made. Recommendations as to airworthiness regulations having to do with monocoque structures. This is a continuing project; estimated cost per year - \$3,000.00.	6,000.00
3. EXPERIMENTAL AIRPLANES - Supervision of the performance of the existing contract with Stearman-Hammond Aircraft Corporation for five experimental airplanes. This contract, although not completed, has been terminated by mutual consent of the Contractor and the Bureau as completion of the contract would serve no useful purpose and would impose a hardship upon the Contractor.	150.00	20. AIRFOIL SPAN AND CHORD LOAD DISTRIBUTION - Cooperation with the National Advisory Committee for Aeronautics in the development of simple methods, checked by flight tests, to predict span and chord distribution on airfoils such as can be easily used in investigating strength and flight characteristics for the purpose of design. Cooperation with the National Advisory Committee for Aeronautics in the correlation of wind-tunnel and flight test data on airfoils. The recommendation as to airworthiness regulations having to do with span and chord load distribution. This is a continuing project; estimated cost per year - \$3,000.00.	6,000.00
4. EXPERIMENTAL AIRPLANE - Supervision of the performance of the existing contract with Arrow Aircraft and Motors Corporation for an experimental airplane.	300.00	21. ABSOLUTE ALTITUDE AND OBJECT DETECTOR - Development of an absolute altimeter, independent of barometric pressure. The instrument developed to be such that it can be used also as an object detector or a collision prevention device.	30,000.00
5. EXPERIMENTAL AIRPLANE - Supervision of the performance of the existing contract with Pauk Aircraft Company for an experimental airplane.	400.00	22. SIMPLE RECORDING ACCELEROMETER - Development of a simple recording accelerometer for use by Bureau inspectors in routine testing and for use in obtaining aircraft landing reactions.	5,000.00
6. EXPERIMENTAL AIRPLANE - Supervision of the performance of the existing contract with Management & Research Incorporated for an experimental tailless airplane.	1,000.00	23. DETERMINATION OF AIRCRAFT LANDING REACTIONS - In cooperation with the National Advisory Committee for Aeronautics, the installation of recording accelerometers in various aircraft to collect data to enable the establishment of the envelope of the landing reaction for both land and water aircraft. Recommendations as to pertinent airworthiness regulations. The estimated cost is based upon the provision that the instruments used will be those bought by the Bureau for inspectors' use after development under Project No. 22.	3,000.00
7. METCALF BLIND LANDING INSTRUMENT AND SYSTEM - Supervision of the performance of the existing contract with Massachusetts Institute of Technology for a blind landing instrument and system.	3,000.00	24. DETERMINATION OF AIRCRAFT HULL PRESSURE DISTRIBUTIONS - In cooperation with the National Advisory Committee for Aeronautics, the installation of pressure recorders in the hulls of various aircraft to collect data for statistically determining design pressure distributions. Recommendations as to pertinent airworthiness regulations. The estimated cost is based upon the provision that the instruments used are those belonging to the National Advisory Committee for Aeronautics.	3,000.00
8. SPERRY AIRPORT ORIENTATOR - Supervision of the performance of the existing contract with Sperry Gyroscope Company for an Airport Orientator, which is an instrument for the reproduction in the aircraft cockpit of a properly orientated chart of an airport. Supervision of the flight testing of the instrument by various airlines.	500.00	25. DETERMINATION OF AIRCRAFT SEA-WING LOADING - Investigation in cooperation with the National Advisory Committee for Aeronautics, of loads imposed upon sea-wings. Investigation of their effect upon the aircraft characteristics involved in its airworthiness. Recommendations as to pertinent airworthiness regulations.	3,000.00
9. AUTOMATIC INSTRUMENT LOG - Supervision of the performance of the existing contract with Fairchild Aerial Camera Corporation for an Automatic Instrument Log, which is an instrument for recording instrument readings and control settings in the aircraft cockpit continuously and automatically. Complete flight testing of the instrument.	6,000.00	26. AIRCRAFT TAKE-OFF AND LANDING MEASUREMENTS - Development, in cooperation with Airport Section and Certificate & Inspection Division, of instruments and necessary technique to measure aircraft take-off and landing for the use of Bureau inspectors.	5,000.00
10. NEW DEVELOPMENTS - Obtaining all available information concerning new developments pertaining to, or having a possible application to aircraft, aircraft instruments, and aircraft equipment. This includes the reading of all technical publications, the obtaining of information from the agencies carrying out the developments, and the inspection of new aircraft, instruments, and devices. This is a continuing project. Estimated cost per year - \$7,600.00	15,000.00	27. AIRCRAFT LANDING LIGHTS - Development, in cooperation with National Bureau of Standards, of suitable landing lights for aircraft. Recommendations as to pertinent airworthiness regulations.	500.00
11. INVENTIONS AND IDEAS - A thorough study of all inventions and ideas submitted to the Bureau with a view to encouraging inventors to further perfect their devices or to including promising inventions or ideas in the Division's development program. This is a continuous project. Estimated cost per year - \$6,000.00	12,000.00	28. LICENSING OF MECHANICS - Thorough study of the subject of licensing airplane and engine mechanics. Recommendations as to the procedure the Bureau should follow in this matter.	2,000.00
12. ICE HAZARDS TO AIRCRAFT - Assistance in the development of suitable means for the prevention of ice formation on aircraft control surfaces, windshields, and instrument pitot heads. Recommendations as to airworthiness regulations having to do with the elimination of the ice hazard. Assistance in the possible further development of wing de-icers and propeller de-icers. Study, in cooperation with the National Advisory Committee for Aeronautics of the fundamental factors concerning ice formation on aircraft.	13,000.00	29. HIGH ALTITUDE FLIGHT - Investigation of the effects of high altitude flying upon those functions of the airplane involved in its airworthiness. Recommendations as to pertinent airworthiness regulations if necessary. Cooperate with Air Transport Section in study of high altitude flying as affecting pilot fatigue and passenger comfort. Recommendations as to pertinent airworthiness regulations if necessary. This is a continuing project; estimates cost per year - \$1,500.00	2,500.00
13. VIBRATION - Thorough study of the entire subject of vibration as it affects the aircraft structure, power plant, instruments, accessories, and equipment. Assistance in the development of equipment to properly detect, measure, and analyze vibrations. Development of technique for the detection, measurement, and analysis of vibrations by testing aircraft and analyzing the test results. Assistance in the formulation of methods for the elimination of dangerous vibrations in aircraft. Recommendations as to airworthiness regulations having to do with vibrations in aircraft. This project probably will continue for two more years at a further estimated cost of \$48,000.00.	48,000.00	30. LIGHTER - THAN - AIRCRAFT - Thorough study of the entire lighter-than-air situation with a view to the Bureau's participation in a National Lighter-than-Air Policy.	2,000.00
14. ULTRA-HIGH FREQUENCY WAVE GENERATOR AND DETECTOR - Development of an ultra-high frequency wave generation and detection device for use in several instrument projects.	10,000.00	31. METCALF BLIND LANDING INSTRUMENT AND SYSTEM - Construction of the Metcalf blind landing system developed under Project No. 7 for actual use by aircraft. Complete flight testing of the system and instrument.	45,000.00
15. LIGHTNING HAZARDS TO AIRCRAFT - Study, in cooperation with the National Advisory Committee for Aeronautics, of the subject of lightning strikes on aircraft and their effect. Development of suitable means for the prevention of accidents or serious damage due to lightning strikes. Recommendations as to airworthiness regulations having to do with lightning strikes. Part of this project probably will continue for two more years at a further estimated cost of \$2,000.00.	3,000.00	32. AIRCRAFT LAUNCHING DEVICES - Thorough study to determine the necessity for a launching device for transport aircraft. Thorough study to determine the best type of device for this use. This project probably will lead to another such as "Assistance, in cooperation with other agencies, in the development of an aircraft launching device", at an estimated cost of \$80,000.00 in the next year.	5,000.00
16. GLIDER CONSTRUCTION MANUAL - Enter into and supervise the performance of a contract with the Soaring Society of America for the compilation of a "Glider Construction Manual" to be published by the Bureau for use in conjunction with its airworthiness regulations having to do with gliders.	500.00	33. MECHANICAL INTERRUPTIONS TO FLIGHT - Thorough study and analysis of mechanical interruption to flight reports and reports of accidents caused by mechanical failures. Recommendations as to changes in airworthiness regulations as a result of this study.	2,000.00
17. PATENT LAWS AND REGULATIONS - A survey of patent laws and regulations as affecting Bureau development contracts and inventions and ideas submitted to the Bureau, and the formulation of appropriate Bureau action and policy.	200.00		

Item	Cost	Item	Cost
34. PARACHUTES - Thorough study of all parachute problems. Recommendations as to regulations pertaining to riggers, jumpers, jumps, and possibly parachutes themselves.	\$1,000.00	47. SIMPLE STRAIN GAUGE - Development of a simple strain gauge for use by Bureau inspectors in routine testing.	\$5,000.00
35. WINDSHIELDS - Development of means to safeguard the pilots and prevent damage to windshields when struck by birds in flight. Recommendations as to pertinent airworthiness regulations. Cooperation with the National Advisory Committee for Aeronautics and National Bureau of Standards in developing a flexible substitute for glass.	2,000.00	48. NEW MATERIALS FOR AIRCRAFT - Cooperation with the National Advisory Committee for Aeronautics and National Bureau of Standards to determine the properties and characteristics of new materials suitable for aircraft use. This is a continuing project; estimated cost per year - \$250.00.	500.00
36. AIRCRAFT WHEELS - Development of improved wheel brakes, with special emphasis on those for larger aircraft. Investigation of the possibilities of an electric brake. Investigation to determine the necessity for anti-corrosion treatment for magnesium wheels. Recommendations as to pertinent airworthiness regulations. Investigation and development of shock absorbing wheels.	1,500.00	49. AIRWORTHINESS AND DESIGN PRACTICE - Correlation of number of accidents for a given type of airplane to determine whether present regulations are producing the safest airplane compatible with reasonable design practice with special emphasis on aircraft used for miscellaneous flying purposes. Thorough study of the aircraft airworthiness requirements with a view to the establishment of minimum design requirements on the basis of "safety" rather than on "reliability".	4,000.00
37. AIRCRAFT POSITION LIGHTS - Study, in cooperation with National Bureau of Standards, of aircraft position light developments. Recommendations as to pertinent airworthiness regulations when considered necessary. This is a continuing project; estimated cost per year - \$75.00.	150.00	50. RECONCILIATION OF THE DIFFERING STRESS-ANALYSIS REQUIREMENTS OF ARMY, NAVY, AND COMMERCE - Cooperation with A-N-C Committee in the reconciliation of the differing stress-analysis requirements of the Army, Navy, and Department of Commerce. Study of these requirements with a view to modification to bring precision and consequent complexity of methods more in line with the assumptions and basic data available concerning loads and load distribution.	500.00
38. AIRCRAFT INSTRUMENT LIGHTS - Study, in cooperation with National Bureau of Standards, of aircraft instrument light developments. Recommendations as to pertinent airworthiness regulations when considered necessary. This is a continuing project; estimated cost per year - \$50.00.	100.00	51. AIRCRAFT WEIGHT AND PERFORMANCE STATISTICS - Tabulation and analysis of the large amount of data concerning airplane weight and performance now in the Bureau files. Publication of these data in the most comprehensive manner; probably graphically. The first step in this project to be the publication of data concerning the take-off characteristics of both land and water aircraft.	800.00
39. AVIATION COLORS - Determination, in cooperation with the National Bureau of Standards, of the optimum specifications for aviation colors. Recommendations as to pertinent regulations.	100.00	52. PATENTED FASTENINGS - Investigation to determine the tests necessary to prove various patented fastenings, such as "Chicago" and "Parker-Kalon", satisfactory for use in the primary structures of aircraft. Recommendations as to pertinent airworthiness regulations.	6,000.00
40. GLIDER OPERATIONS MANUAL - Enter into and supervise the performance of a contract with the Soaring Society of America for the compilation of a "Glider Operations Manual" to be published by the Bureau for use in conjunction with its airworthiness regulations having to do with gliders.	500.00	53. WING RIB TESTING MACHINE - Development of a universal rib testing machine by means of which ribs may be tested by the application of load rationally distributed chordwise.	1,000.00
41. ACCELEROMETER - Development of an instrument, or instruments, to obtain and record all three components of linear and angular accelerations of an aircraft, both in flight and in landing.	20,000.00	54. COMMON AIRCRAFT MATERIALS - Correlation and publication of all available data concerning allowable fibre stresses for the common aircraft materials.	200.00
42. GROUND SPEED INDICATOR - Study of the possibilities of obtaining a true ground speed indicator. Obviously, the value of such an instrument would be very great indeed. Its development would require a considerable expenditure of funds.	3,500.00	55. JONES METHOD OF BOUNDARY LAYER CONTROL - Thorough study of the Jones method of boundary layer control. Assistance in the development of this method of boundary layer control.	25,000.00
43. TWO-CONTROL AIRCRAFT - Investigation of "two-control" operation as it affects the aircraft's airworthiness. Recommendations as to pertinent airworthiness regulations if necessary.	2,500.00	56. SENSITIVE ALTIMETERS - Study of existing types of sensitive altimeters with a view to providing closer limits of accuracy.	200.00
44. EFFECTS OF AGE AND USE UPON AIRCRAFT - Investigation of the effects of age and use upon the strength of typical aircraft structures. Recommendations as to pertinent airworthiness regulations if necessary. The estimated cost is based upon the provision that all static tests would be conducted by the Army free of cost.	15,000.00	57. GROUP INSTRUMENTS - Assistance in the development of group instruments.	500.00
45. GENERATOR FAILURE WARNING LIGHT - Development of a warning light in the cockpit of an aircraft to indicate failure of the electric generator.	1,000.00	58. WING BEAMS - Development of a satisfactory method of analyzing box-type wing beams subjected to combined bending and torsion.	500.00
46. SIMPLE ACCELEROMETER - Development of a simple $g_{max}$ accelerometer for use by Bureau inspectors in routine testing.	5,000.00	59. STRESS ANALYSIS OF LOW-WING MONOPLANES - Development of an alternative special method of stress analysis for low-wing monoplanes which form such a large part of current production.	800.00
Net Total . . . . .			338,570.00
Additional sum required for advisory services not represented by specific projects (20% of net total) . . . . .			77,714.00
Reserve for emergency projects (10% of net total) . . . . .			33,857.00
GRAND TOTAL . . . . .			\$450,141.00

NOTE: Costs are to July 1, 1939, in the case of continuing projects.



AIRPORTS SECTION

Item	Cost	Item	Cost
1. FINANCIAL AND PHYSICAL SURVEYS - A nation-wide survey is in progress and will continue during the next fiscal year to determine existing facilities on all airports in the United States, together with the capital on all airports in the United States, together with the capital investment of each airport, annual maintenance cost, operating expenditures, annual income, etc. In connection with the above surveys, vertical photographs of all airports and seaplane bases to scale are being obtained and these are to be checked by actual measurements against data submitted. Completion of these surveys will require several months and will necessitate further attention to keep the information current. A survey is being made affecting the reliability of electrical power supply to major airports with the view of determining where stand-by power plants will be needed. These surveys will enable the Airport Section to intelligently plan future airport development and construction, based on actual data which will be tabulated from the above surveys.	\$67,120.00	7. SEAPLANE FACILITIES - A survey of existing seaplane facilities and a study to determine future requirements as to location, equipment and size, considering local and international air traffic and also present any possible future requirements of seaplane traffic. In view of the current interest in trans-oceanic possibilities, this study is of particular importance since no extended research has ever been made of this problem.	\$17,660.00
2. LONG RANGE PROGRAM OF AIRPORT AND AIRWAY DEVELOPMENT - The Airport Section consults with states, municipalities, aircraft manufacturers and others interested in greater safety and convenience in aeronautical operation at airports in the United States to the end that development of a coordinated civil airway system and the improvement of airports may keep pace with other aeronautical developments. Research and planning is conducted in connection with other government departments such as the Army, Navy, National Advisory Committee on Aeronautics, Post Office, National Park Service and the aviation industry as a whole, for the purpose of coordinating all ideas, studies and information in the formulation of a comprehensive long-range program of airport and airway construction and development. The necessity for long-range planning, particularly where federal expenditures are involved, is essential for future development in order that costly errors made in the past may be eliminated.	76,180.00	8. FACILITIES FOR PROTECTION OF AIRLINE PASSENGERS ENTERING AND LEAVING AIRCRAFT - The research necessary to determine, as requested by the Air Transport Association, the facilities and equipment necessary for the protection and convenience of airline passengers embarking and disembarking from airplanes.	5,700.00
3. TESTS TO DETERMINE TAKE-OFF AND LANDING CHARACTERISTICS OF AIRCRAFT - Further development and tests of the four electrical synchronized range finding cameras which are being used at present to secure information at key airports throughout the United States. The accumulation of this information will be continued, which will be utilized to determine the exact take-off and landing distances required by different type airplanes in different atmospheric conditions and at different altitudes, together with rate of climb immediately after take-off.	28,220.00	9. AIRMARKING - Continuation of the present air marking program, Survey to Determine actual conditions of present air markers as to location, type, condition and other pertinent information and to determine what additional air markers should be developed. Preparation of the necessary records to keep all data in connection with this survey and program current. The development of a national plan for use in connection with present and future federal and state air marking programs. Preparation of a bulletin on air marking construction to replace obsolete bulletins which are out of publication.	26,940.00
4. AIRPORT RATING REGULATIONS - Rapid advancement in the aircraft industry has necessitated a revision in the airport rating regulations of the Bureau of Air Commerce. The Airport Section has been concerned with the preparation of new airport rating regulations which were discontinued in 1933. It is anticipated that these regulations will be completed and placed into effect during the next year. This project includes the drafting and publication of the new regulations, the field inspection and the office routine in connection with rating of airports. (Air Commerce Act of 1926).	55,300.00	10. AIRPORT ZONING - Includes: (a) Determination of airport approaches necessary now and in the future, considering airplane performance and airport construction; based on information and research of BAC. (b) Study of legal problems arising in connection with airport zoning, based on court decisions and available literature. (c) Preparation of bibliography on subjects of approaches and zoning. (d) Procurement and analysis of all existing airport zoning legislation of states, counties, and municipalities. (e) Assistance to political subdivisions and airport operators with zoning phases of airport planning and with other zoning problems, both by correspondence and by conferences. (f) Preparation of bulletin to take place of the Report of the Committee on Airport Zoning and Eminent Domain, published by the BAC under date of December 18, 1930, and now out of date and incorrect in several important particulars. (g) Preparation of suggested airport zoning ordinance. (h) Preparation of the material on approaches and zoning for all publications of the BAC regarding airport construction or layout (such as proposed Handbook), and for the rating regulations. (i) Recommendations to the Certificate and Inspection Division concerning changes in the regulations governing the maneuvering of airline aircraft in landing and taking-off. (j) The handling of all other matters of airport approaches and zoning as they arise.	12,100.00
5. LABORATORY AND FIELD TESTS OF PAVING AND OTHER AIRPORT FACILITIES - Conducting laboratory studies on soils, paving, drainage, lighting, including studies of hangar design and runway construction. Joint studies are being initiated through other federal agencies and Universities, together with the Asphalt Institute, on soil characteristics and paving materials, including special studies of airport drainage. Tests of existing and new lighting equipment for the purpose of standardizing airport lighting. Studies in connection with runway layouts, hangar design, administration building, fire control methods, snow control and traffic control.	48,680.00	11. DEVELOPMENT AND TEST OF FOG PIERCING LIGHT - Test and installation of a Fog Landing Light System. It is proposed to make the first installation at Sacramento, where fog is frequent and regular. Installations at other locations will be made for experimental purposes.	8,700.00
6. REVISION OF OBSOLETE AIRPORT BULLETINS - The present Bureau of Air Commerce airport bulletins are obsolete. Revision of all airport bulletins to bring them up to date and into conformity with the projected regulations and with present day requirements.	39,600.00	12. TEST OF AIRPORT BEACONS - Purchase and flight test of newly developed oscillating type beacon. It is proposed to purchase one beacon of this type, and have it installed at Washington Airport. The flight checking could be incidental to the normal use of the airport. Other tests will be made to determine the desirability of placing this in regular use and at other locations.	3,500.00
		13. INSTALLATION AND TEST OF RUNWAY REFLECTOR UNITS - The runway reflector units are a relatively inexpensive method of marking runway edges. These units pick up the landing lights of a plane, and show the pilot clearly where the edges of the runway are. The air transport companies, and many of the airport managers have expressed great interest in the possibilities of these units. It is proposed to conduct tests on this unit in several locations to determine its usefulness.	3,500.00
		14. DEVELOP AND TEST SUITABLE AIRPORT RUNWAY ILLUMINATORS - This is the development of an idea for floodlighting a runway from small units distributed along the runway edges. It is proposed to install units for test purposes at old Bolling Field.	2,000.00
Net Total . . . . .			395,200.00
Additional sum required for advisory services not represented by specific projects (20% of net total) . . . . .			79,040.00
Reserve for emergency projects (10% of net total) . . . . .			39,520.00
		GRAND TOTAL . . . . .	\$513,440.00

NOTE: Costs are to July 1, 1939, in the case of continuing projects.

AIR TRANSPORT SECTION

Item	Cost	Item	Cost
1. PILOT MEDICAL STUDY - Study of pilot fatigue and making of recommendations with reference to more accurate physical and mental requirements for pilots. Study of oxygen requirements and report thereon to industry. Continuing project.	\$55,000.00	18. SAFETY REQUIREMENTS AT AIRPORTS - Study of means for providing greater safety in the conduct of passengers before and after leaving aircraft at airports, together with study of extent of jurisdiction of the Bureau of Air Commerce along these lines. In cooperation with Airport Section. Continuing project.	\$750.00
2. ACCIDENT SURVEY - Detailed study of airline accidents since 1934 and those in miscellaneous flying since 1931. Report and recommendations as to future development to avoid repetitions.	3,500.00	19. POLARIZED LIGHT - Investigation of method of application of certain lenses now available, to the end that reflected light (glare) from parts of aircraft and instrument panel may not cause pilot eye strain, which it is believed contributes largely to pilot fatigue. Allied to Pilot Medical Study and in cooperation with Aircraft Section. Continuing project.	2,500.00
3. SPACING AIR LINES SCHEDULES - Study of air traffic at important terminals and recommendations for relieving congestion.	750.00	20. PASSENGER MEDICAL STUDY - Study of requirements necessary to the safety, health and comfort of scheduled airline passengers. Study includes such problems as ventilation, temperature control, lavatory facilities, determination of altitudes to which average passengers may safely ascend and effects of rapid ascents and descents.	5,000.00
4. ALTERNATE ADJACENT AIRPORTS - Study of possibility of use of several airports to relieve congestion at crowded air terminals. This project closely allied with Project No. 3.	500.00	21. MEDICAL EXAMINERS REPORTS FOLLOWING ACCIDENTS - Study and setting up of procedure for the making of special reports by Bureau Medical Examiners on pilots whom they have recently examined and who are involved in an accident. These reports are for the purpose of more intelligently passing upon the capabilities of pilots under such circumstances.	100.00
5. COORDINATION OF PILOTS' DUTIES - Study and making of recommendations regarding logical and efficient division of duties of airplane crews.	600.00	22. OXYGEN INHALING APPARATUSSES - Coordinating of manufacturers' efforts to provide practicable means of administering oxygen to crew and passengers when high altitude flights are necessary. This project is aside from research in field of supercharged cabins. Allied to Pilot Medical Study Program.	5,000.00
6. DEAD RECKONING AVIGATION - Investigation of this method of aerial navigation and establishment of definite limits.	800.00	23. QUARANTINE RESTRICTIONS - Study of problem of flare-ups of various infectious and contagious diseases believed to result from long flights at high altitudes. This project will include the making of recommendations for protective measures and supplying findings with Public Health Service. Continuing program.	1,000.00
7. TIME SYNCHRONIZING ALONG AIRWAYS - Investigation and study looking to method for synchronizing, as to time, ground dispatching stations with operating aircraft.	300.00	24. CABIN SUPERCHARGING - Study of this problem with a view to determining values from passengers health and comfort standpoint.	750.00
8. IMPROVED WEATHER REPORTING - Study of method for better dissemination of weather information as reported by pilots in flight. Study contemplates investigation of actual requirements and making of recommendations.	800.00	25. PROGRAM OF STATE COOPERATION - Many of the Bureau's objectives can be aided in large measure through the help of the several States' aeronautical commissions. A logical project is that of presenting many of the Bureau's problems to these bodies and securing help in enforcement and other ways.	1,500.00
9. INSTRUMENT LANDING TRAINING - Establishment of program for the training of flying personnel in use of blind landing equipment. Suitable equipment for this program would be set up and maintained at several advantageous and accessible locations throughout the country.	1,200.00	26. STATE LICENSING OF PRIVATE FLYING - Study of proposal for placing private flying in the hands of the States and the licensing of private airplanes by State Boards. Federal Bureau would still specify minimum requirements as to airworthiness of planes, instruction qualifications for pilots licenses, and Approved Type Certificate to manufacturers for type.	500.00
10. ADDITIONAL AIRWAYS NEEDS - Economic studies with reference to ground transportation flow and other matters in connection with establishment of additional airways.	5,000.00	27. CONFINING PRIVATE FLYING TO AIRPORTS NOT HANDLING COMMERCIAL SCHEDULES - Study of the feasibility of requiring private fliers to confine their activities to airports not handling commercial traffic.	500.00
11. PILOT RETIREMENT PLAN - Study of subject of need for scientific retirement plan for pilots. Pilot ineffectiveness in many cases believed due to worries over possible loss of job and future activities after being retired as active pilot. Continuing project.	1,200.00	28. FIRST AID KITS - Study and drafting of specifications for improvement and modernization of first aid kits. Recommendations as to measures for perpetuating usefulness of kits after installation.	500.00
12. ADEQUATE FUEL STORAGE INSPECTION - Development of means for the prevention of accidents due to water in gasoline. Problem appears comparatively simple from mechanical standpoint but application of remedial measures present difficulties.	200.00	29. EMERGENCY SUPPLIES ABOARD AIRCRAFT - Study of desirability of requiring the carrying of emergency supplies for use in the event of an accident or forced landing in a remote location.	200.00
13. BONE CONDUCTION HEARING DEVICE - Investigation of apparatus designed to accomplish better reception of radio range and voice signals under static conditions, prevent diminution of hearing under conditions of rapid descent and prolong the usefulness of a pilot's career by preventing deafness.	500.00	30. ADDITIONAL USES FOR AIRCRAFT - Study and investigation of the development of types for purposes not presently used. Continuing project.	500.00
14. METEOROLOGICAL RADIOGRAPHS - This method of exploring weather aloft now being investigated by Harvard University. Assistance of the Bureau of Air Commerce needed. Continuing project.	2,500.00	31. AIRLINE COST STUDIES - Economic study of airline costs as affecting safety activities, even though indirectly.	750.00
15. GROUND PERSONNEL MEDICAL STUDY - Study of physical and mental capabilities of ground personnel in view of increasing amount of exact work demanded of such personnel. This study allied with Project No. 1. Continuing project.	1,500.00	32. GROUND TRANSPORTATION BETWEEN AIRPORTS & CITIES - Study with reference to improving conditions to the end that less time and distance is lost between commercial airports and metropolitan centers.	1,500.00
16. AIRWAY BEACON SURVEY - This project contemplates study of existing aids and recommendations, if considered necessary, for types and locations of additions. Survey will include light beacons, radio ranges and special radio location signals.	4,000.00	33. LAND PLANES VS. SEA PLANES FOR TRANS-OCEANIC FLYING - Study and recommendations.	500.00
17. INSTRUMENT ARRANGEMENT - Study and recommendations to manufacturers with reference to arrangement of aircraft instruments and controls with the view of minimizing the presently existing complexities of the cockpit. In cooperation with Aircraft Section and allied to Pilot Medical Study. Continuing project.	400.00		
Net Total . . . . .			100,400.00
Additional sum required for advisory services not represented by specific projects (20% of net total) . . . . .			20,080.00
Reserve for emergency projects (10% of net total) . . . . .			10,040.00
GRAND TOTAL . . . . .			\$130,520.00

NOTE: Costs are to July 1, 1938, in the case of continuing projects.

## EDUCATIONAL SECTION

## INTERNATIONAL SECTION

## POWER PLANT SECTION

Item	Cost
1. COOPERATION WITH EDUCATIONAL AGENCIES - Generally, will work in close cooperation with Federal Educational agencies and with State and Municipal bodies with reference to matters of aviation education. Continuing project.	\$12,500.00
2. MAINTENANCE OF EDUCATIONAL RECORD - Compile and keep currently accurate a list of schools giving aviation courses, academic or trade, such list to classify type of instruction and degrees or certificates given. Continuing project.	500.00
3. DETERMINE EDUCATIONAL NEEDS - Determine the type and number of school-trained employees needed in the aviation industry.	1,000.00
4. COORDINATE EDUCATIONAL NEEDS AND STUDENT OUTPUT - Compile and disseminate results of studies looking to coordinating the number of students and the types of instruction with the needs of the industry. Continuing project.	2,700.00
5. SECURE AND DISSEMINATE TEACHING MATERIAL - Determine the needs of the schools as to accurate aviation teaching material and take steps to secure such material for them. Continuing project.	4,000.00
6. INTEREST STUDENTS AND FACULTY IN SPECIFIC INVESTIGATIONS - Interest undergraduates or post graduate students or instructors in special aviation studies needed in connection with the work of the Safety & Planning Division and make arrangements therefor. Continuing project.	15,800.00
7. STABILIZATION OF THE EDUCATIONAL QUALIFICATIONS OF PERSONNEL - Stabilization of the qualifications of personnel and the passing back to the educational institutions, educational specifications for careers in aviation as being fundamental for regulation and flight promotion. Continuing project.	2,700.00
8. HARMONIZE CURRICULI - Work toward similar types of instruction for comparable degrees or certificates in the various schools. Continuing project.	1,000.00
9. STUDY FOREIGN AVIATION EDUCATIONAL METHODS - Obtain information relative to aviation educational systems and methods used in other countries and determine if the U.S. may profitably use similar procedures. Continuing project.	5,000.00
10. ASSIST SCHOOLS IN OBTAINING TEACHING PERSONNEL - Assist the faculties of aviation schools in obtaining competent teaching personnel. Continuing project.	100.00
Net Total . . . . .	45,100.00
Additional sum required for advisory services not represented by specific projects (20% of net total) . . . . .	9,020.00
Reserve for emergency projects (10% of net total) . . . . .	4,510.00
GRAND TOTAL . . . . .	\$58,630.00

Item	Cost
The purpose of this section is to build up a source of international aeronautical information that will be accessible to the Bureau of Air Commerce and the Industry; and to represent the Director locally, and in foreign countries on International Civil Aviation as, if and when the opportunity presents itself.	
Program includes following projects:	
a. Generally, study and compilation of information concerning every phase of civil aeronautics, the extent thereof, the rate of growth, and the probable expansion, with particular reference to plans for the future in connection with national and international expansion that may possibly affect the United States from the standpoint of air transportation as well as from the standpoint of expansion of commerce.	
b. Compile information concerning all foreign and other international air transportation systems.	
c. Compile information concerning the method and degree of Government subsidy of various European and South American air lines.	
d. Compile information concerning the types of aircraft, accessories and general equipment used.	
e. Compile information concerning the total of personnel employed, by classifications.	
f. Compile information concerning flight time limitations for pilots and other crew personnel.	
g. Compile information concerning maintenance methods, procedures and equipment used, and details of government regulations governing operation.	
h. Compile information concerning the extent and type of navigation facilities supplied by the Government and by the individual operators, including all information on meteorological facilities and methods used.	
i. Study of foreign technique of operation, training and control of personnel, etc.	
j. Compilation and study of foreign physical standards required, frequency of physical and professional qualification examinations, etc.	
k. Compilation and study of information for use in establishing or revising reciprocal agreements between the United States and other Nations in matters pertaining to Civil Aeronautics.	
l. Compilation of available technical information as to new developments in aircraft, engines and propellers, and all aircraft accessories, including radio.	
m. Maintain a close contact and cooperate with the foreign aeronautical offices of the various Departments of the United States Government.	
n. Cooperate with all United States foreign representatives with reference to the expansion of foreign markets for American civil aircraft and accessories.	
o. Represent the Secretary of Commerce in conferences held abroad, relating to civil aeronautics.	
p. Represent the Secretary of Commerce with foreign purchasers of American aircraft in matters relating to questions that arise from time to time, particularly with such large purchasers of American aircraft as the K.L.M. of Holland.	
q. Compile information concerning the amount of capital invested in each operation and division of ownership of various European and South American air lines.	
Net Total . . . . .	\$8,000.00
Additional sum required for advisory services not represented by specific projects (20% of net total) . . . . .	1,600.00
Reserve for emergency projects (10% of net total) . . . . .	800.00
GRAND TOTAL . . . . .	\$10,400.00

Item	Cost
1. ASSISTANCE IN DEVELOPMENT OF POWER PLANT INVENTIONS - This fund to be used for contracts for the development of promising inventions in aviation power plants, including engines and accessories and propellers.	\$75,000.00
2. DEVELOPMENT OF OIL ENGINES - This fund to be used in the encouragement of the development of oil engines, in which this country is far behind. Additional funds will probably be required in subsequent years.	100,000.00
3. DEVELOPMENT OF TWO STROKE CYCLE ENGINES - This fund to be used for contracts to encourage the development of the two stroke cycle engine.	60,000.00
4. DEVELOPMENT OF BARREL TYPE TWO STROKE CYCLE OIL ENGINE - This fund to be used to continue the development of the barrel type engine, a development already started under contract.	30,000.00
5. TESTS FOR AIRWORTHINESS SECTION - This fund to be used for conduct of tests to assist in the proper determination of airworthiness requirements. Mostly for allocation to Bureau of Standards.	15,000.00
6. REDUCTION OF FIRE HAZARDS - This fund for miscellaneous tests looking toward a reduction in fire hazards.	10,000.00
7. ACCESSORY COST STUDY - Investigation and tests relative to application of the products of other industries to aviation use with view toward reducing high cost of power plant accessories.	10,000.00
Net Total . . . . .	300,000.00
Additional sum required for advisory services not represented by specific projects (20% of net total) . . . . .	60,000.00
Reserve for emergency projects (10% of net total) . . . . .	30,000.00
GRAND TOTAL . . . . .	\$390,000.00

NOTE: Costs are to July 1, 1939, in the case of continuing projects.

RADIO DEVELOPMENT SECTION

Item	Cost	Item	Cost
1. FLIGHT TESTS OF SIMULTANEOUS RANGE - Tests of Knoxville and Roanoke radio ranges to determine the effects of counterpoises for simultaneous operation. Work on this project completed and report prepared.	\$1,894.00	16. MARKER IDENTIFICATION - Study for determining most suitable means for positively identifying radio marker beacons which are to be located on radio range courses.	\$1,000.00
2. ULTRA-HIGH FREQUENCY RADIO RANGE - Development work on use of ultra-high frequencies for radio ranges, for purpose of obtaining greater stability of courses, elimination of atmospheric static and considerable saving in cost per station. Some work accomplished and preliminary report prepared. Continuing project.	40,000.00	17. SIMULTANEOUS ULTRA-HIGH FREQUENCY RADIO RANGE - Further development of the ultra-high frequency radio range to incorporate simultaneous voice broadcast and radio range service similar to that now provided by low frequencies. Continuing project.	15,000.00
3. BLIND LANDING - Continued development of an instrument landing system with a view toward making installations on national scale. Coordination of work being done in industry and refinement of service equipment urgently needed. Continuing project.	66,000.00	18. FIELD INTENSITY MEASUREMENTS - Conduct field intensity survey on all existing radio range and broadcast stations operated by Bureau, and measurements as required on foreign interfering stations. Survey necessary to accomplish economical assignment of extremely limited number of radio frequencies available. Continuing project.	14,000.00
4. TESTS ON NEW SIMULTANEOUS RANGES - Inspection and tests of first simultaneous range station, in Bureau's new construction program, to be located at Hartford, Connecticut. Due to novelty of new equipment to be used, design must be given rigid inspection.	5,880.00	19. INSULATOR ICE - Thorough field study to determine the effectiveness of insulating or heating base insulators on towers for prevention of ice formation on insulators. Formation of ice on insulators may cause changes in course orientation with serious consequences.	10,000.00
5. ULTRA-HIGH FREQUENCY AIR TRAFFIC CONTROL - Development of 125 Mc. ground station transmitters and antennas and aircraft receivers to provide suitable air traffic control facilities eliminating atmospheric static and interference now present on 273 kc. Some work accomplished. Continuing project.	10,000.00	20. ULTRA-HIGH FREQUENCY RADIO COMPASS - Development of ultra-high frequency radio compass for use aboard aircraft. Such a compass capable of operating at ultra-high frequencies would be free from static interference and an invaluable flying aid.	30,000.00
6. ULTRA-HIGH RADIO RANGE RECEIVER - Development of aircraft receiver, and complete specifications therefor, to be used for entire ultra-high frequency radio range spectrum. One experimental receiver has been constructed and now being tested. Report being prepared. Continuing project.	15,000.00	21. MONITORING FAN TYPE MARKER BEACONS - Study to determine the most suitable means for remote monitoring of fan type marker beacons.	5,000.00
7. ACCEPTANCE TESTS ON FAN MARKER EQUIPMENT - Complete factory testing of transmitters to be used for fan markers, and flight tests on first installation at New Brunswick. Continuing project.	3,000.00	22. DEVELOPMENT CONTRACTS - Investigate all new patents in aviation radio field and conduct study of equipment developed thereunder. This project includes the purchase of sample units for test prior to service application. Continuing project. *Cost per year.	*15,000.00
8. ULTRA-HIGH FREQUENCY RADIO RECEIVERS - Development and test of "Z" type and fan type radio marker receivers. Project includes sponsorship of further development by radio manufacturers looking to commercial availability of this type of receiver.	15,000.00	23. POSITIVE ALTIMETER - Investigation of possibilities of developing a positive altimeter for aircraft, the accuracy of which shall be essentially independent of barometric pressure, temperature, and humidity. Instrument would provide reading of altitude above ground rather than above sea level. In cooperation with Aircraft Section. Continuing project.	10,000.00
9. IMPROVEMENT IN FAN MARKERS - Improvement and refinement of ultra-high frequency fan markers which provide definite "fixes" to pilots approaching radio range stations and provide obstruction warnings. Preliminary report written. Flight tests to be conducted. Continuing project.	5,000.00	24. COLLISION WARNING DEVICE - Study problem of collision warning for aircraft and conduct study of various possible methods. Allied with aircraft instrument development and work on positive altimeter. Continuing project.	20,000.00
10. ULTRA-HIGH FREQUENCY "Z" MARKER BEACON - Further development work on the ultra-high frequency "Z" marker transmitter and antenna system. Equipment developed and ready for installation at range stations on airways. Further development necessary to keep abreast of continual progress in this field.	5,570.00	25. GROUND RADIO DIRECTION FINDER - Investigate systems of radio direction finding and study problem of developing equipment suitable for installation at Bureau ground stations to provide facilities for taking directional bearings on aircraft in flight. Allied to study of radio compass.	20,000.00
11. ULTRA-HIGH FREQUENCY GROUND & GROUND TO AIRCRAFT COMMUNICATIONS SYSTEM - Development of and preparation of specifications for equipment to provide complete ultra-high frequency airway communications system. This will provide a broadcast and teletype channel for ground to aircraft and two or more 60-word-per-minute ground teletype channels for weather and air traffic control communications. Some work already accomplished and report written. Continuing project.	25,000.00	26. RADIO RECEIVER DEVELOPMENT - Develop methods of automatically tuning radio receivers in Bureau ground stations for positive reception of calls from aircraft and apply certain circuit refinements for suppression of extraneous interfering noises.	2,000.00
12. EXPERIMENTAL RADIO RANGE STATION - Construction of an experimental radio range station where problems of radio range operation may be investigated without interruption of range service on existing airways. Need for such station is considered very urgent.	46,000.00	27. RADIO RANGE QUADRANT IDENTIFICATION - Investigation of possible methods of providing individual code identification of range quadrants as an aid to solution of blind flying orientation problems. Determine by experimentation advisability and practicability of application to all range stations. Two year project.	5,000.00
13. IMPEDANCE BOXES - Development of a more satisfactory impedance measuring device. Involves investigation of present equipment which is used in tuning radio range stations with a view toward improving equipment for accuracy and sensitivity.	1,500.00	28. MONITORING SYSTEMS FOR RADIO NAVIGATION AIDS - Investigate methods and conduct experimental development of a system for a positive indication of irregularities in operation of important radio aids to air navigation. Includes checking of radio range course deviations, normal functioning of cone of silence and traffic control markers, and possibility of recording of voice broadcast of weather information and radio phone communication with aircraft. System will be useful also in training of personnel in standard operating methods and procedure. Continuing project.	20,000.00
14. IMPROVEMENT IN THE EXISTING AIRWAY AIDS - Development work looking to improvement and refinement of existing airway radio facilities. This project will keep the Bureau abreast with the latest technical and scientific advances of the radio industry. Continuing project.	30,000.00	29. VISUAL RADIO RANGE DEMONSTRATOR - Construction of radio range demonstrator operated by light sources and capable of illustrating multiple courses, fades, and other idiosyncrasies of radio range transmission. This development would make available a device for improving a pilot's understanding of the phenomena involved when encountering peculiarities in radio range transmission.	2,000.00
15. PRECIPITATION STATIC - Sponsoring and directing further work on the elimination of precipitation static, most pressing problem of air transport industry from navigation standpoint. Some progress made by airlines. Bureau requested to lead aid in further development.	25,000.00		
Net Total . . . . .			462,324.00
Additional sum required for advisory services not represented by specific projects (20% of net total) . . . . .			92,464.80
Reserve for emergency projects (10% of net total) . . . . .			46,232.40
GRAND TOTAL . . . . .			\$601,021.20

NOTE: Costs are to July 1, 1939, in the case of continuing projects.

# SUMMARY OF ESTIMATED NEEDS

Activity	No. of Projects	Amount
Aircraft Section	59	\$450,141.00
Airports Section	14	513,440.00
Air Transport Section	33	130,520.00
Educational Section	10	58,630.00
International Section	17	10,400.00
Power Plant Section	7	390,000.00
Radio Development Section	29	601,021.20
	<hr/>	<hr/>
TOTALS	169	\$2,154,152.20
Available for 1937-38		251,000.00
		<hr/>
Balance needed for 1938-39		\$1,903,152.20