U. S. DEPARTMENT OF COMMERCE

CIVIL AERONAUTICS JOURNAL

ISSUED TWICE MONTHLY BY THE CIVIL AERONAUTICS AUTHORITY

VOLUME 1 WASHINGTON, OCTOBER 1, 1940 NUMBER 19

Fall Session of C. P. T. P. Started; 15,000 Students Expected To Enroll

Minimum Age Limit Raised From 18 to 19 Years; Administrator Connolly Says Several Changes Effected in Fall Curriculum

Some 15,000 students were expected to enroll in the preliminary course of the Civilian Pilot Training Program fall session, which got underway in 500 colleges and universities on September 15. The courses are scheduled for completion by January 31, 1941.

In announcing the beginning of the new phase of the C. P. T. Program, Col. Donald H. Connolly, Administrator of Civil Aeronautics, stated that the minimum age limit of students had been raised from 18 to 19 years, with the maximum age remaining at 26.

As a result of close study of the methods employed in the past, several changes are being effected in the fall curriculum, Colonel Connolly said, which will tend to simplify both ground and flight instruction. The subjects of navigation and meteorology will now take in 24 classroom hours each instead of 15 as previously, and classes in the Civil Air Regulations (from the standpoint of the private pilot) will be reduced from 12 to 6 hours.

Flight maneuvers, including an integrated treatment of applied theory of flight and aerodynamics, flight and engine instruments, engine servicing, aircraft inspection, routine maintenance and parachutes have been grouped into a course designated as "Aircraft Operation" and will cover 24 classroom hours including the 6 devoted to the Civil Air Regulations. These classes will be conducted in the colleges by the flight instructors instead of the ground instructors as heretofore.

It also is proposed to return to the original practice of having 1 instructor to each unit of 10 students and to charge each student for medical examination and flight insurance as well as a payment not to exceed $10 which will be made to the college as a registration fee.[1]

MILITARY PLEDGE REQUIRED

Colonel Connolly also announced that new candidates for the pilot training program will be asked to pledge themselves to enter the military air services if qualified. This pledge is not intended to set the time or circumstances for entering the military service, he said, but rather to provide a statement of intention to use this particular training in the national defense.

In a bulletin to the participating institutions, the C. A. A. pointed out that outstanding male students in the preliminary course may be recommended for the secondary course, which gives a pilot a cumulative total of 200 ground-school and 80 hours of flight work, at the end of which he will be given consideration for further training. The preliminary course covers 72 hours of

[1] Instruction in the summer session was given to units of 15 by 1 instructor, and there was no charge made to the participant. In the 1939-40 program the ratio of 1 instructor to 10 students was established and fees up to $40 covering insurance, ground instruction, physical examination, etc., were charged by the colleges.

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C. P. T. Fall Session

(Continued from preceding page)

ground and a minimum of 35 hours of flight training.

With a view to making as many graduates as possible available to the military services, all applicants are required to pass the regular military physical examination before being accepted.

"More than a thousand young men are now completing secondary work in our summer classes," Colonel Connolly said, "and there will be 3,000 more engaged in it next month. In addition, 5,000 trainees are scheduled for the second semester of the 1940–41 school year, so that before next June 30, we will have turned out 9,000 of these secondary pilots, each with at least 80 hours in the air."

C. A. A. Leases St. Petersburg Airport for Standardization Center

The Grand Central Airport at St. Petersburg, Fla., has been leased by the Civil Aeronautics Administration on a dollar-a-year basis for the establishment of a standardization center for inspectors, Col. Donald H. Connolly, Administrator of Civil Aeronautics, announced on September 11.

Details of the services to be provided at the center now are being worked out and activities will not begin until late in the autumn.

"While we cannot be specific pending present discussion as to funds available for staffing and operating the field," Colonel Connolly said, "the center has been planned to meet growing needs for uniform Nation-wide practice in the various inspection services related to civil aviation.

"We have learned from experience that much more uniform standards can be achieved by inspection personnel in such a rapidly expanding program if

(Continued on page 444)

Insurance Rates for C. P. T. P. Students Reduced Again: Premium Now $9 for $3,000

Reduction is third voluntary cut by companies in year and a half—new premium less than one-third of original rate

Life and accident insurance premiums to cover students in the Civilian Pilot Training Program have been reduced again this fall—the third voluntary reduction by insurance companies in about a year and a half, because of the unparalleled safety record of the program, Col. Donald H. Connolly, Administrator of Civil Aeronautics, announced on September 15.

Previous to this program, the premium for $3,000 coverage of a student pilot during the training period was $35. The first rate set for this controlled program was $20. By last fall, because of the good safety record of the course, this was reduced to $14. At the opening of this year's summer course it was slashed to $10. Now, for the autumn course, it is being reduced to $9, a figure less than one-third of that which actuaries felt would be needed at the outset.

"In the entire 20 months of the training program," Colonel Connolly said, "only 4 primary students and 1 secondary student have been killed. Two of these were last year and 3 this year. There also have been 4 instructor fatalities. These cover approximately 28,000 flight courses—10,000 during the last school year and 18,000 this summer. They also cover more than 1,100,000 hours of flying.

"This means that, including fatalities of instructors as well as students, well over 100,000 hours have been flown for each fatality. This means flying about 7,000,000 miles per fatality, or 280 times around the world for each person killed.

"Up to the beginning of this program, the best record achieved in light plane flight-instruction for the country as a whole was 12,000 hours for each fatality.

"In short, the entire Civilian Pilot Training program, to date, has been about eight times safer than any other previous average for the country."

Colonel Connolly pointed out that this record has been made in spite of many difficulties. First, the new training program launched this summer was much larger than last year. It also was compressed in time. Whereas one group of students took the entire school year of 1939–40 to complete the preliminary course, there will be three successive courses completed this year. The first course, which has run all summer, will produce some 15,000 preliminary graduates, 1,100 secondary graduates, and 1,000 refreshed instructors within the next 30 days. Another complete set of courses will be run during the first half of the school year, and a third during the second half.

"When you multiply the number of people in training sixfold, include a variety of advanced courses with more difficult operations and then compress your courses into half the time you formerly allowed," the Administrator explained, "it is inevitable that there is some increase in hazard.

"We have enlarged and accelerated this program because Congress has given us the money and the instructions to build quickly a huge backlog of young pilots with a limited amount of training, who can serve as a reservoir from which the military services can draw cadets.

"This summer, people in our program have flown about 700,000 hours. They have flown about 7,000 hours per day. That is about twenty times around the world each day, for training only. Traffic has been increased tremendously at hundreds of commercial airports where this work has been going on.

"We feel the record is a remarkable one, and we especially are happy to learn that the actuarial experts of the insurance companies agree with us to the extent of making a further reduction in their premiums."

CORRECTION

The story on page 412 of the CIVIL AERONAUTICS JOURNAL for September 1, 1940, vol. I, No. 17, stated that *Civil Air Regulations No. 65* had been amended by the Civil Aeronautics Board. This was in error: The Board adopted *amendment No. 65* to the Civil Air Regulations. The amendment relates to revisions of part 20 governing the renewal and special issuance of certificates.

NEW AERONAUTICAL PUBLICATIONS

Among recent Government publications dealing with the subject of aeronautics are the following:

HOUSE POST OFFICE AND POST ROADS COMMITTEE; hearings on H. R. 9851 and H. R. 9992, bills authorizing special arrangements in the transportation of mail within the Territory of Alaska, 26 pages, price 5 cents. Classification number Y 4.P 84/1: Ai 7/16.

SENATE POST OFFICES AND POST ROADS COMMITTEE; hearings on S. 4137, a bill relating to transportation of foreign mail by aircraft, 7 pages, price 5 cents. Classification number Y 4.P 84-2: Ai 7/6.

HOUSE POST OFFICE AND POST ROADS COMMITTEE; hearings on H. R. 10091, a bill relating to transportation of foreign mail by aircraft. 8 pages, price 5 cents. Classification number Y 4.P 84/1: Ai 7/17.

When ordering these publications, send remittance by postal money order, express order, coupons, or check to the Superintendent of Documents, Government Printing Office, Washington, D. C. Always give title, issuing office, or classification number when listed.

CAMPAIGN AGAINST CRASHES!

AIR SAFETY

Safety Bureau to Publish Individual Accident Reports

Plans for Brief Notes on Single Crashes to Point Out Causes, Contributing Factors, and Observations for Prevention

In the belief that the publication of brief reports on individual aircraft accidents—pointing out the causes, contributing factors, and observations for prevention—will go far toward lowering the private flying accident rate, the Safety Bureau of the Civil Aeronautics Board has inaugurated this practice as a part of its "Campaign against Crashes."

Many aircraft accidents occur because of carelessness; failure to observe the Civil Air Regulations; failure to employ the common sense rules of flying; one official of the Safety Bureau said: "It is hoped that, by releasing brief reports on individual accidents—pointing out the moral of the story, so to speak—crashes which might have been prevented will not happen to others."

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A Weak Belt Is a False Security.—At Beverly Airport, Beverly, Mass., about 3:45 p. m. on February 25, John Potter, a solo pilot with 34 hours and 43 minutes, while engaged in a noncommercial flight, met with an accident that resulted in his serious injury. The plane was a Piper Model J-3, certificate No. NC 20287. Potter was practicing accuracy landings on a field adjoining the Beverly Airport when he commenced a 180° landing maneuver with the throttle closed. The pilot stalled the aircraft at an altitude of about 85 feet during a gliding turn and the aircraft fell into a right spin, which continued until it struck the ground on its nose and right wing. The aircraft was demolished. The pilot received serious injuries when his safety belt failed at the moment of impact causing him to be thrown clear of the wreckage.

The Probable Cause.—Pilot stalled the aircraft during a turn at low altitude.

Contributing Factor.—Inexperience of the pilot.

Observations.—Pilots should guard against the tendency to stall when they overshoot while making a spot landing. It is safer to miss the mark and try again. Weak safety belts give a false sense of security. Belts should be replaced when they become worn or frayed.

Thunderstorm Approached—Pilot Did Not Get Down in Time.—Near Henderson, Ky., about 11:40 a. m. on April 17, James Verbal Collins, a solo pilot with 477 hours, while engaged in a noncommercial cross-country day flight, met with an accident which resulted in his fatal injury. The aircraft was a Piper Model J3C-50S. Collins, accompanied by a passenger, took off from the Ohio River at Henderson, on a pleasure flight to Louisville. Upon arriving at Louisville, a heavy ground fog was encountered, causing the pilot to return to Henderson. As he neared Henderson, a light rain began to fall. A normal landing was made on the river but before the aircraft could be taxied to shore a thunderstorm struck. High wind overturned the aircraft about 300 feet off shore, and both occupants, unhurt, began swimming toward shore when the aircraft started to sink. Witnesses put out in boats and picked up the passenger but failed to reach the pilot before he drowned. The passenger's condition, due to exposure and exhaustion, was serious. Both wings of the aircraft received minor damage during salvage.

The Probable Cause.—High wind overturned the aircraft following a landing on water.

Observation.—This flight might have ended with less unhappiness if more attention had been given to planning it.

Plane Stalls Above Airport.—Near North Islip, N. Y., about 3:45 p. m. on March 17, Peter J. Cane, pilot, and A. Rosenberg, student, while engaged in a training flight, met with an accident that resulted in serious injuries to both pilot and student. Cane held commercial certificate No. 26217 with a 2S–Land and Instructor's rating, and at the time of the accident had flown a total of approximately 1,900 hours. The aircraft, a Fairchild KR-34-C, certificate No. NC-290K, sustained major damage. Pilot Cane, accompanied by Student Pilot Rosenberg, approached the Islip Airport for a landing following an instructional flight. As the aircraft reached a point about 300 yards south of the airport and at an altitude of about 100 feet, it stalled and fell to the left, making about a half turn in a spin before striking the ground. The student was flying the aircraft until the instructor took the controls at the time the aircraft stalled. The impact resulted in destruction of the aircraft, and serious injuries to both occupants.

The Probable Cause of the Accident Was.—Failure of the pilot to supervise properly a student flight.

Student Pilot Violates Sound Practice.—Near Hayti, Mo., about 11:30 a. m. on April 21, Richard Jackson, a student pilot with unknown hours, while engaged in a noncommercial day flight, met with an accident which resulted in his fatal injury. The plane was a Piper Model J-2. Pilot Jackson, accompanied by a passenger, took off from a landing field near Hayti, on a local flight. Several loops were executed at an altitude of about 700 feet over the northeast corner of the airport. The aircraft then was placed in a steep climbing attitude, which continued until an altitude of approximately 1,000 feet was reached when it stalled. The aircraft then entered a right spin, making about four turns before striking the ground just east of the airport boundary. Witnesses state that after the aircraft had made two turns of the spin, full power was applied momentarily which made it spin faster. The impact with the ground resulted in destruction of the aircraft and fatal injuries to both occupants. Subsequent investigation disclosed that the aircraft was equipped with fully functioning dual controls. There was no evidence of power plant or structural failure of the aircraft prior to impact.

The Probable Cause.—Failure of the pilot to recover from a spin.

Contributing Factor.—Inexperience of the pilot.

Turn at Low Altitude.—Near Fort Ripley, Minn., about 5:45 p. m. on April 22, Bertram L. Iten, a solo pilot with 119 hours, while engaged in a noncommercial day flight, met with an accident which resulted in his fatal injury. The plane was an Aeronca Model 65-C. Iten took off from his private flying field near Fort Ripley on a flight to Brainerd, Minn. Following the take-off, he circled the field several times at low altitude, diving and zooming, and while turning down wind at an altitude of about 150 feet, the aircraft stalled and fell to the ground on its wheels and nose. The impact resulted in destruction of the aircraft and fatal injuries to the pilot.

The Probable Cause.—Pilot stalled aircraft during a turn at low altitude.

Inadequate Planning.—At Yelland Field, Ely, Nev., about 7 p. m. on February 26, Milton L. Carpenter, a private pilot with 850 hours, while engaged in a

(*See* ACCIDENT REPORTS, *page 436*)

Private Flying

Summary of Active Certificates

(As of September 1, 1940)

Pilot certificates of competency	42,645
Airline transport pilot certificates of competency	1,277
Student pilot certificates	39,524
Glider pilot certificates of competency	133
Student glider pilot certificates	426
Mechanic certificates of competency	10,412
Parachute rigger certificates of competency	407
Certificated aircraft	14,940
Uncertificated aircraft	502
Certificated gliders	35
Uncertificated gliders	100
Repair stations holding certificates of competency	194
Ground instructors certificates of competency	1,002
Air-traffic control-tower operators certificates of competency	244
Air carrier dispatchers certificates of competency	311

Accident Reports

(*Continued from page 435*)

noncommercial night cross-country flight, met with an accident that resulted in serious injury. The plane was a Piper Model J3C-50. Carpenter, having flown a passenger from Ely to Wendover, Utah, departed on the return trip about 5 p. m. The aircraft was not equipped for night flying, and official sunset at Ely on this date was 5:28 p. m. The flight to Wendover had required about an hour and a half, however, headwinds of about 17 miles per hour were encountered on the return trip, and the pilot arrived over Ely about 7 p. m., at which time it was completely dark. There was on one at the airport to turn on the boundary lights and he descended in a left spiral, using passing automobile lights for reference, until the left wing struck the ground at a point about 2,000 feet from the airport boundary. The aircraft cartwheeled over onto its nose and right wing, and the pilot, who was thrown from the aircraft, received serious injuries. The aircraft was demolished.

The Probable Cause.—Action of the pilot in attempting a flight to terminate in darkness with an aircraft not equipped for night flying.

Observation.—Headwinds should be given particular attention when sunset is imminent.

Stalled in a Low Wing-Over.—At Waikiki Beach, Honolulu, T. H., about 9:30 a. m. on February 4, Charles W. M. Clapp, a private pilot with 150 hours, while engaged in a noncommercial day flight, met with an accident which resulted in serious injury. The plane was a Piper Model J3C-50. Pilot Clapp, accompanied by a passenger, was flying over the water about a quarter mile offshore at Waikiki Beach when he attempted a wing-over from an altitude of about 250 feet. The aircraft stalled at the top of the turn and dived into the water and was demolished. Both occupants received serious injuries.

The Probable Cause.—Pilot stalled aircraft during a steep climbing turn at a low altitude.

Observation.—Depth perception over water may be very deceptive.

Crash in a Homemade Aircraft.—At Knox Airport, Knox, Ind., about 4:30 p. m. on March 17, Carl V. Malott, a student pilot with unknown hours while flying a homemade aircraft met with an accident which resulted in serious injury. The plane had not been certificated. Malott took off from Knox Airport and, after making several turns in which he was observed to skid the aircraft, fell in to a right spin at a low altitude. He recovered and then went into a flat spin to the left, which continued until the aircraft struck the ground and was demolished.

The Probable Cause.—Pilot stalled the aircraft while executing a turn at low altitude.

Contributing Factor.—Inexperience of the pilot.

Observation.—An inexperienced pilot and a homemade aircraft are a dangerous combination.

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DESIGNATION OF MEDICAL EXAMINERS

During the month of August 1940 the following physicians officially were authorized as medical examiners for the Civil Aeronautics Administration in the cities named:

California.—Dr. Orville W. Cole, 305 Professional Building, Long Beach, Dr. Gilbert J. Roberts, 586 North Main Street, Pomona, and Dr. Thornwald Johnson, 603 North Hockett, Portersville.

Connecticut.—Dr. H. Bruno Arnold, 1460 Chapel Street, New Haven.

Delaware.—Dr. Newell R. Washburn, 6 Causey Avenue, Milford.

Georgia.—Dr. Braswell E. Collins, 701 Elizabeth Street, Waycross.

Iowa.—Dr. George B. Johnson, 514½ Central Avenue, Estherville.

Michigan.—Dr. Thomas R. Rees, Seaman Building, Ironwood.

Minnesota.—Dr. Lawrence M. Larson, Medical Arts Building, Minneapolis.

Missouri.—Dr. Phillip H. Bassett, 1200 South Big Bend Boulevard, St. Louis.

Nebraska.—Dr. F. M. Tushla, 1102 Fourteenth Street, Auburn, Dr. Roy C. Noble, 516½ Court Street, Beatrice, and Dr. Linville F. Valentine, 204 West Fifth Street, North Platte.

New Hampshire.—Dr. Bernard P. Haubrich, Latchis Building, Claremont.

North Dakota.—Dr. Robert W. R. Rodgers, Walton Block, Dickinson.

Ohio.—Dr. Gerald J. Krupp, 2703 Broadway, Lorain.

Oklahoma.—Dr. Phil E. White, 311 Perrine Building, Oklahoma City.

Pennsylvania.—Dr. John S. Miller, Jr., 517 Welsh Street, Chester, Dr. William F. Weitzel, Church and Ninth Streets, Indiana, Dr. William D. Beamer, Fishkin Building, Tarentum, and Dr. Quay A. McCune, 510 Pennsylvania Avenue, East, Warren.

Texas.—Dr. Walton G. Stephens, 412 South Main Street, Borger, and Dr. G. Mason Kahn, Medical Arts Building, Galveston.

Utah.—Dr. Carvel S. Evans, 1002 Medical Arts Building, Salt Lake City.

Wyoming.—Dr. James G. Allison, Wheatland.

Alaska.—Dr. Milo H. Fritz, Merchants and Miners Bank Building, Ketchikan.

Brazil.—Dr. Edgard B. Tostes, Ed. Cinema Gloria—Sala 305, Praca Floriano Peixota, Rio de Janeiro.

The following named physicians have changed their addresses during the month, their new addresses being as follows:

Dr. Francis G. Herzog, 802 Avalon Building, Wilmington harbor district, Los Angeles.
Dr. Walter G. Bishop, 705 Professional Building, Greenwood, S. C.

The following-named physicians no longer are conducting physical examinations:

Dr. John A. Martin, Montgomery, Ala.
Dr. John J. Hombach, North Platte, Nebr.
Dr. George H. Clapp, Erie, Pa.

Duplicate Certificates

For the convenience of those persons whose certificates have been lost or destroyed, the Civil Aeronautics Administration has ordered that duplicate certificates may be issued upon request.

Certificates which will be duplicated include the following:

1. All classes of airman certificates.
2. Aircraft registration certificates.
3. Aircraft airworthiness certificates.
4. Airmen and aircraft record forms.

The price per page for such duplicated certificates will be $1. All correspondence concerning duplicate certificates should be addressed to Chief, Certificate Section, Civil Aeronautics Administration, Washington, D. C.

Airways and Airports

Airport Projects Approved

In accordance with the provisions of section 303 of the Civil Aeronautics Act, the Administrator of the Authority has issued certificates of air navigation facility necessity, authorizing the expenditure of Federal funds in the operation of the following projects:

ALBANY, GA.—$174,582 for W. P. A. project including erection of two hangars, each 124 by 160 feet and the grading of the central portion of the field to provide an all-way landing area. Lighting, previously contemplated but never initiated, is included at Albany-Dougherty County Airport.

BOISE, IDAHO—$5,627 for W. P. A. project consisting of construction of a 50- by 32-foot workshop requiring 150 cubic yards of excavation and grading, 3,000 concrete blocks, 16 squares of roofing and carpentry, wiring and plumbing at Boise-Bench Municipal Airport.

BOURNE, MASS.—$666 for N. Y. A. project including clearing brush, stumps, roots and assist in grading two 300-foot lanes for airplane runways; runway to be about 150 feet in width, at Bourne Airport.

DAYTONA BEACH, FLA.—$157,928 for W. P. A. project improving Daytona Beach Municipal Airport by constructing a NE.-SW. runway 100 by 3,500 feet; extending present SE.-NW. runway 100 by 649 feet, to a length of 3,500 feet; extending present N.-S. runway 100 by 1,070 feet, to a total length of 3,500 feet; grading, installing drainage facilities, installing and resetting lights and markers, mucking and sprigging, and performing incidental and appurtenant work at municipal airport.

DULUTH, MINN.—$513,365 for W. P. A. project for construction of 3 asphaltic runways 3,800 feet in length and 100 feet in width, 2 taxi-ways 1,050 feet and 450 feet in length and 75 feet in width, installation of 55 boundary lights, 18 range lights, and 12 flood lights, installation of beacon, remodeling and insulating the existing hangar, and constructing an additional lean to for office purposes at Duluth Airport.

FORT SMITH, ARK.—$37,775 for continuation of W. P. A. project dated January 5, 1940. Pave runways, taxi strips, aprons, and ramps. Install boundary range and obstruction lights, and rotary beacon at municipal airport.

IRON MOUNTAIN, MICH.—$16,103 for W. P. A project to improve the Ford Airport near Iron Mountain, Dickinson County, by constructing hangar, grading, sodding, seeding, landscaping, and performing appurtenant work at this airport.

LAKELAND, FLA.—$179,345 for W. P. A. project for construction of one hangar 100 by 120 feet with 2 units (lean-to type) 25 by 120 feet. Install 22 plumbing fixtures with all roughing-in. Installation of complete lighting system; 40 acres of clearing and grubbing, 25,000 cubic yards of fill, and 168,370 square yards of soil cement runway paving, together with affiliated work at municipal airport.

LITTLE ROCK, ARK.—$460,249 for W. P. A. project to improve municipal airport (Adams Field) by grading, draining, fencing, lighting, and paving 2 runways 4,100 by 150 feet and 3,570 by 150 feet, and the extension of a third runway 1,650 by 150 feet. Construct taxi strips, walks, aprons, loading ramps, and other appurtenant and incidental work. Construction of Administration Building two stories in height. Construction of 18-inch stone walls clear-span truss-floor and roof construction with concrete slabs. This supersedes previous approval dated June 18, 1940.

MYRTLE BEACH, S. C.—$35,023 for W. P. A. project, authorizing expenditures for continued operation of a previous project. Work includes 12 acres of clearing and grubbing, 35,100 cubic yards of common excavation, 200 lineal feet of 18-inch RC pipe installation and affiliated work at municipal airport.

PALATKA, FLA.—$62,172 for W. P. A. project for construction of four sod landing strips 3,500 feet in length and 500 feet in width with all approaches cleared to 30-to-1 glide ratio. Clear, grub, grade, ditch, drain pipe, sod, sprig, etc., at Palatka Municipal Airport.

PANAMA CITY, FLA.—$148,623 for W. P. A. project, including 145 acres of clearing and grubbing, 180,887 cubic yards of fill, 100,000 cubic yards of hydraulic borrow and fill, 92,800 square yards of 6-inch asphaltic stabilization, and 370,000 square yards of top soil and sprigging to establish three runways, together with affiliated items of basic work at Bay County Airport.

TEMPORARY AIRPORTS OF ENTRY

Certain airports and seaplane bases are designated as airports of entry through which aircraft arriving in the United States from foreign countries may clear customs and immigration.

A complete list of such airports of entry appeared in the Civil Aeronautics Journal, vol. 1, No. 11, dated June 1, 1940. The following temporary airports of entry have been redesignated for another period of 1 year following the date given:

Airport	*Date*
Sault Ste. Marie Airport, Sault Ste. Marie, Mich.	**Aug. 4, 1940**
Warroad Seaplane Base, Warroad, Minn.	**Sept. 2, 1940**

PORTSMOUTH, OHIO.—$3,276 for erection of 100- by 100-foot airport hangar, grading area and runways, installation of drainage tiles and ditches at airport one-half mile east of Haverhill on Route No. 52. Grade four strips 1,320, 1,800, 2,230, and 2,260 feet in length, each 300 feet wide, at municipal airport.

PRESQUE ISLE, MAINE.—$44,473 for W. P. A. project for developing N.-S. runway 3,500 feet in length and 500 feet in width including safety bands in accordance with plans, specifications, and grades established and approved by the C. A. A. on its plan dated June 29, 1940. Proposed work to include clearing, grading, drainage, and surfacing and when completed will constitute a usable unit of the master program for the completed airport at Presque Isle.

PROVO, UTAH.—$3,210 for N. Y. A. project for construction of hangar 60 by 60 feet. Extend present runway 1,000 feet. Improve present runways. Install 300 linear feet French drain. Grade extension area 800 cubic feet fill. Construct new road to run way extension area. Build road to hangar. Complete marking of field at municipal airport.

PULLMAN, WASH.—$28,628 for W. P. A. project including grading, draining, surfacing, and lowering power and telephone poles, together with appurtenant and incidental work. Project includes 8,700 cubic yards of common excavation, 10,800 lineal feet of drain-pipe installation, 70,000 square yards of bituminous surfacing, moving 30 power poles, and installing 52 catch basins and 10-day markers at Pullman Airport.

SACRAMENTO, CALIF.—$7,822 for W. P. A. project to improve airport near Sacramento, by constructing sewage pumping station, sidewalks, curbs, and gutters, and guard rails, installing drainage and performing other incidental and appurtenant work at municipal airport.

SARASOTA, FLA.—$313,815 for W. P. A. project for construction of three runways 3,500 feet in length and 100 feet in width, three taxiways 75 feet in width, totaling 3,800 feet in combined lengths. Clearing of approaches to runways on 30-to-1 glide ratio and installation of complete boundary, range, and affiliated aeronautical lighting at Manatee-Sarasota Counties Airport.

Aeronautical Charts

During August the following new editions of aeronautical charts were issued by the United States Coast and Geodetic Survey. Pilots are warned that the previous editions of the same charts are canceled and are now obsolete.

PRICES REDUCED

As of September 1, the price of aeronautical charts has been reduced. Whereas regional and direction finding (DF) charts sold for 75 cents each, they now are 40 cents each. Sectional charts, formerly 40 cents each, now are 25 cents each. On orders grossing $10 or more, a 33⅓ percent discount is allowed. Copies of these charts may be obtained from the Coast and Geodetic Survey, Washington, D. C., and from recognized dealers at major cities and airports.

New Edition of Regional Aeronautical Chart

15-M.—July 1940. Size, 26 by 37 inches. Located in latitude 26°-32° N., and longitude 97°-106° W., covering an area of about 246,000 square miles. Numerous changes in air navigation facilities.

New Edition of Direction Finding Chart

22-DF.—August 1940. Size, 25 by 34 inches. Located in latitude 38°-49° N., longitude 85°-108° W., an area of some 225,000 square miles. Accumulation of changes since last edition.

New Editions of Sectional Aeronautical Charts

Austin.—August 1940. Size, 20 by 47 inches. Located in latitude 30°-32° N., longitude 96°-102° W., covering an area of about 57,000 square miles. Radio range from San Antonio relocated, new radio range from Yoakum added, and inclusion of changes since last edition.

Orlando.—August 1940. Size, 20 by 33 inches. Located in latitude 28°-30° N., longitude 80°-84° W., covering an area of some 25,000 square miles. Radio ranges added at Orlando and Cross City, and civil airways added.

Salt Lake City.—July 1940. Size, 20 by 41 inches. Located in latitude 40°-42° N., longitude 108°-114° W., an area of about 51,000 square miles. New radio range at Fort Bridges, Tintic radio range realined, and radio range at Knight deleted.

San Diego.—August 1940. Size, 20 by 46 inches. Located in latitude 32°-34° N., longitude 114°-120° W., an area of about 55,000 square miles. Beacons relocated on the Los Angeles to Phoenix airway, and civil airways revised.

Shreveport.—August 1940. Size, 20 by 46 inches. Located in latitude 32°-34° N., longitude 90°-96° W., covering an area of about 56,000 square miles. New radio range at Monroe, Shreveport radio range realined, and civil airways revised.

Recognized Dealer

The Coast and Geodetic Survey has announced the addition of the following name to the list of dealers authorized to sell charts:

Virginia Airmotive, municipal airport, Roanoke, Va.

Manufacturing and Production

Flight Load Factors: —

Aircraft Airworthiness Section Report Gives Information on Load Factors for Large Airplanes

Because of the interest that has been shown in the series of Aircraft Airworthiness Section reports on aircraft load factors, the CIVIL AERONAUTICS JOURNAL here presents the full text of REPORT No. 6, HISTORY, GUSTS, LARGE AIRPLANES.

While this report is of primary use to designers and manufacturers of aircraft, it has been used as a reference by others interested in the subject.[1]

Part I—History, Gusts, Large Airplanes

Objects:

(a) To review the background on which present load factor requirements are based.

(b) To discuss the gust load factor requirements.

(c) To consider possible revision of the maneuvering load factor requirements for large airplanes.

1. INTRODUCTION

The values of the load factors used in designing an airplane are almost direct measures of its strength. They also affect the weight of a certain portion of the airplane structure. Although the *percentage* of gross weight that depends directly on the magnitude of the design load factors is not as large as might be supposed, it represents a considerable potential pay load on large airplanes and therefore warrants careful consideration of the basic question: *What is the minimum load factor consistent with safety?*

Naturally this question does not have the same answer for all airplanes. The possible effects of weight, size, power, manner of operation, and many other factors enter into the picture. The speeds at which the load factors are assumed to be applied also affect the loads in the airplane structure. This last point has already been discussed in some detail in AIRCRAFT AIRWORTHINESS SECTION REPORTS 4 AND 5; this paper will therefore deal more directly with the magnitude of the load factors themselves.

[1] Report No. 6 covers only part I of the subject. Report No. 8, which covers part II, MANEUVERING LOAD FACTORS, will be published in a subsequent issue of the CIVIL AERONAUTICS JOURNAL. This latter report is being used in the Civilian Pilot Training Program in conjunction with Report No. 7, GUST LOAD FACTOR PRINCIPLES, and Report No. 10, AIRPLANE LOAD FACTOR INFORMATION FOR PILOTS.

2. DEFINITION OF LOAD FACTOR

The term "load factor," although almost as old as the art of airplane design, does not have a unique meaning and therefore must be treated with some care in any discussion of this type. The general definition is given by CAR 04.119 as "the ratio of a load to the design weight." Thus a load factor of 4 implies that the load in question is four times the weight of the airplane. Whether this load is acting on the wings, landing gear, or some other part of the structure is a matter of further definition. It is also necessary to specify whether the load is an *actual* load, an *anticipated* load, a *test* load, or any one of a number of different types of loads that must be considered by the designer. Typical definitions of this sort are included in CAR 04.119 to 04.125. These will be followed in this paper and should be referred to in case there is any doubt as to the kind of load factor in question.

3. HISTORY OF THE LOAD FACTOR REQUIREMENTS

An excellent discussion of the present design requirements for flight loads is given by Niles and Newell in AIRPLANE STRUCTURES, volume 1, second edition, pages 22 to 28. This discussion brings out the natural division of the problem into two parts: *maneuvering* load factors and *gust* load factors. As pointed out by Niles and Newell, the original maneuvering load factors were based on actual accelerations obtained in flight maneuvers. (These tests were made by the Army Air Corps in the years preceding the beginning of civil air regulation in 1926). To avoid establishing categories or weight classifications the commercial load factors were made to depend on *gross weight* and *power loading*. Up to 1932 the design load factor was given by a chart based on these two variables. (See fig. 1.)

1932–34.—In 1932 this chart was modified by increasing the load factors for airplanes with low power loading (highly powered with respect to weight). This revision consisted in changing the slope of the lines on the load-factor chart, starting at a power loading of 12. The factors were not changed for power loadings greater than 12.

1934–37.—In 1934 the requirements were revised considerably in form. The main object of this revision was to introduce certain basic performance and design characteristics without appreciably changing the status of existing airplanes. This was done mainly by means of empirical equations for design speeds, ajusted to agree with previous practice. (See AIRCRAFT AIRWORTHINESS SECTION REPORT No. 4 for other changes made at this time.)

No substantial change in the maneuvering load factors was introduced in the 1934 revision, as the studies of this subject had not revealed any system that seemed to be entirely suitable. It was realized (reference 6) that the existing load-factor charts neglected the important characteristics of wing loading and drag loading (cleanness). These were covered to some extent, however, by the adoption of *gust* load factors (which depended on wing loading and speed) and by the inclusion of the drag loading in the gliding speed formula. (This took care of the torsional loads on the wing.)

The maneuvering load-factor charts were replaced by an empirical equation that gave a smoother transition but did not change the load factors appreciably. (See fig. 1.) The minimum value of design load factor was dropped from 4.0 to 3.75, mainly because of satisfactory experience with very large flying boats. (See later discussion of this.)

Since the 1934 revision involved a correlation of loading conditions with

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NEW TYPE APPROVALS

[Approval numbers and dates of assignment in parenthesis]

TYPE CERTIFICATES

Aircraft

Rearwin, 175, two-place closed land monoplane. Engine, Continental A-75-8 (729, August 16, 1940).

Ross, RS-1, two-place open land monoplane. Engine, Continental A-40-4 or A-40-5 (732, August 28, 1940).

Engines

Aviation Manufacturing, Lycoming O-233-A1 four cylinder horizontal opposed air cooled, 100 horsepower at 2,500 revolutions per minute at sea level pressure altitude (223, August 26, 1940).

Propellers

Freedman-Burnham, PX-2 propeller, aluminum alloy hub and wooden blades, adjustable pitch; limits dependent upon blade model installed—maximum diameter, 6 feet 3 inches, 80 horsepower, 2,650 revolutions per minute (746, August 6, 1940).

Freedman-Burnham, PY-2 propeller, aluminum alloy hub and wooden blades, adjustable pitch; limits dependent upon blade model installed—maximum diameter 6 feet 3 inches, 80 horsepower 2,650 revolutions per minute (747, August 6, 1940).

U. S. Air Industries, 5726A, wood, 6 feet 4 inches diameter, 3 feet 3 inches pitch, 50 horsepower 1,900 revolutions per minute (748, August 5, 1940.)

actual flight conditions, it was necessary to split the design load factor into two parts—an "expected" or "actual" load factor, and a factor of safety. The latter was taken as 1.5, to represent a *minimum* value.

The load factor obtained by dividing the design load factor by the factor of safety of 1.5 was called the *applied* load factor. A new requirement was added to insure that this factor could be withstood without permanent deformation of the structure.

1937–Present.—About 1935 there was a design trend toward the use of increased power for take-off, probably as a result of improvement in engine design. Since the extra power was a definite safety factor from a performance standpoint, it seemed irrational to discourage its use by requiring higher load factors. Through a series of memoranda to aircraft manufacturers a general change in policy was therefore established, the final results of which appeared in 1937 (CAR 04). The most important changes (from a strength standpoint) were:

(*a*) The designer was permitted to choose values for design speed and power that were independent of actual engine power (CAR 04.105).

(*b*) A maximum required value for maneuvering load factors was established at a power loading of 12 (fig. 04–3).

(*c*) Operational limits were set up to correspond to the values of speeds and power chosen as a basis for design.

The first of these changes (*a*), permitted the designer to increase the power of an airplane without any additional analysis except for the structure immediately affected by the engine torque. In most cases the design procedure consisted in choosing a value for the level flight speed (VL) and "working backward" to obtain the corresponding design power.

The second change (*b*), amounted to reversing previous policy and eliminating the variation of load factor with power loading for all highly powered airplanes. (See fig. 1.) A survey of existing commercial airplanes had shown that about the only ones that would be affected by this change were those with excess power for take-off. The adoption of a definite upper limit for load factor was also intended to encourage designers to use this limit in the original design, so as to avoid any question of load factor changes with increased power. A further reason for establishing an upper limit was the fact that gust load factors and placards had also been introduced and these were expected to offset the need for higher load factors at reduced power loadings.

Item (*c*) mentioned above results in the use of a placard for the high speed in level flight (V_L). This had originally been set up as a cruising speed placard, but was recently changed to V_L. (Amendment No. 5, March 1939.) This placard was intended to offset the possible use of the additional power for increased speed, in normal operations.

To give a better picture of the history of the maneuvering load factors, the requirements have been plotted on figure 1, using *ultimate* factors in all cases.

The *gust* load factor requirements have remained practically unchanged since their inclusion in 1934, except for the adoption in 1937 of a reduction factor for airplanes having low wing loadings. (CAR 04.2121.) In the 1938 AIR COMMERCE MANUAL 04, however, it was recommended that this factor be extended into the range of high wing loadings, in which case it causes an increase in the effective gust velocity (fig. I–1, appendix I, CAAM 04).

PRESENT LOAD FACTOR TERMINOLOGY

In 1937 (CAR 04) the terms *design* and *applied* were replaced by *ultimate* and *yield*, both of these terms referring to loads that must be withstood by the structure (reference CAR 04.122 to 0.125). A new term, "*limit*," was introduced to specify the actual or expected load factor. Under the new system the *limit* load factor represents the value for which the airplane is expected to be completely airworthy. (See also definition in CAR 04.120.) *It therefore represents a definite flight limitation for airworthy operation.* (The term "limit" was adopted by agreement between the Army, Navy, and Bureau of Air Commerce, as a result of work done by the ANC Committee on Aircraft Requirements.)

In discussing the maximum load factors likely to be imposed on an airplane, we normally will be dealing with *limit* load factors. It should be noted, however, that the structural weight is usually determined by the *ultimate* load factor. Consequently, it is often necessary to consider *ultimate* load factors, especially when comparing the requirements of various agencies. (Many foreign countries use a factor of safety of 2.0, instead of 1.5.)

PREDICTION OF LOAD FACTORS

The basic problem of determining suitable load factor requirements is usually regarded as *predicting*, for a given type or class of airplane, the maximum load factor likely to be imposed during the life of the airplane. Such predictions may be based on statistics, or on analytical studies, or a combination of both. The statistical method has been used from the earliest days of airplane design. NACA Technical Memorandum 716 describes tests made in Germany in 1914, from which certain load factor data were obtained. As previously mentioned, the United States maneuvering load factor requirements are still based on flight acceleration measurements made prior to 1926. Unfortunately, the collection of suitable load factors statistics for United States commercial airplanes was almost abandoned for a number of years following the first writing of the airworthiness requirements. During the last few years, however, the use of the $V\text{–}g$ recorder (reference 7) has provided load factor records that are particularly valuable because of their correlation with

AIRCRAFT INSPECTION REPRESENTATIVES

Finding that it is required to best effectuate the purposes of the Civil Aeronautics Act, and is desirable in the public interest, Col. Donald H. Connolly, Administrator of Civil Aeronautics, has ordered the designation of aircraft inspection representatives, for the examination, inspection, and approval of certificated aircraft.

The full text of the order, issued under section 308 of the act, is as follows:

"(1) The Chief of the Certificate and Inspection Division is hereby authorized to designate such persons or agencies as he may deem qualified and necessary to examine, inspect, and approve certificated aircraft. Such persons or agencies shall be known as aircraft inspection representatives and the approval of any such aircraft as airworthy, or the examinations or reports of any such representative, may be accepted in lieu of those made by officers or employees of the Administrator.

"(2) Any such designation shall terminate at any time the Chief of the Certificate and Inspection Division shall determine that such person or agency is no longer properly qualified as such aircraft inspection representative."

Aircraft Radio Equipment Approved for Scheduled Air Carrier Use

During the month of August, the following units of aircraft radio equipment were approved by the Civil Aeronautics Administration and issued type certificates (no authorized modifications to type certificated equipment were issued during the month):

Certificate No.	Manufacturer	Unit	Date
299	Thos. L. Siebenthaler Manufacturing Co.	Type 78A azimuth bearing indicator	Aug. 26
445	RCA Manufacturing Co.	MK-1 automatic radio direction finder receiver part No. 644490.	Aug. 13
483	Braniff Airways, Inc.	5A power unit	Aug. 12
552	Bendix Radio Corporation	RA-1B receiver	Do.
553	do	RA-1J receiver	Do.

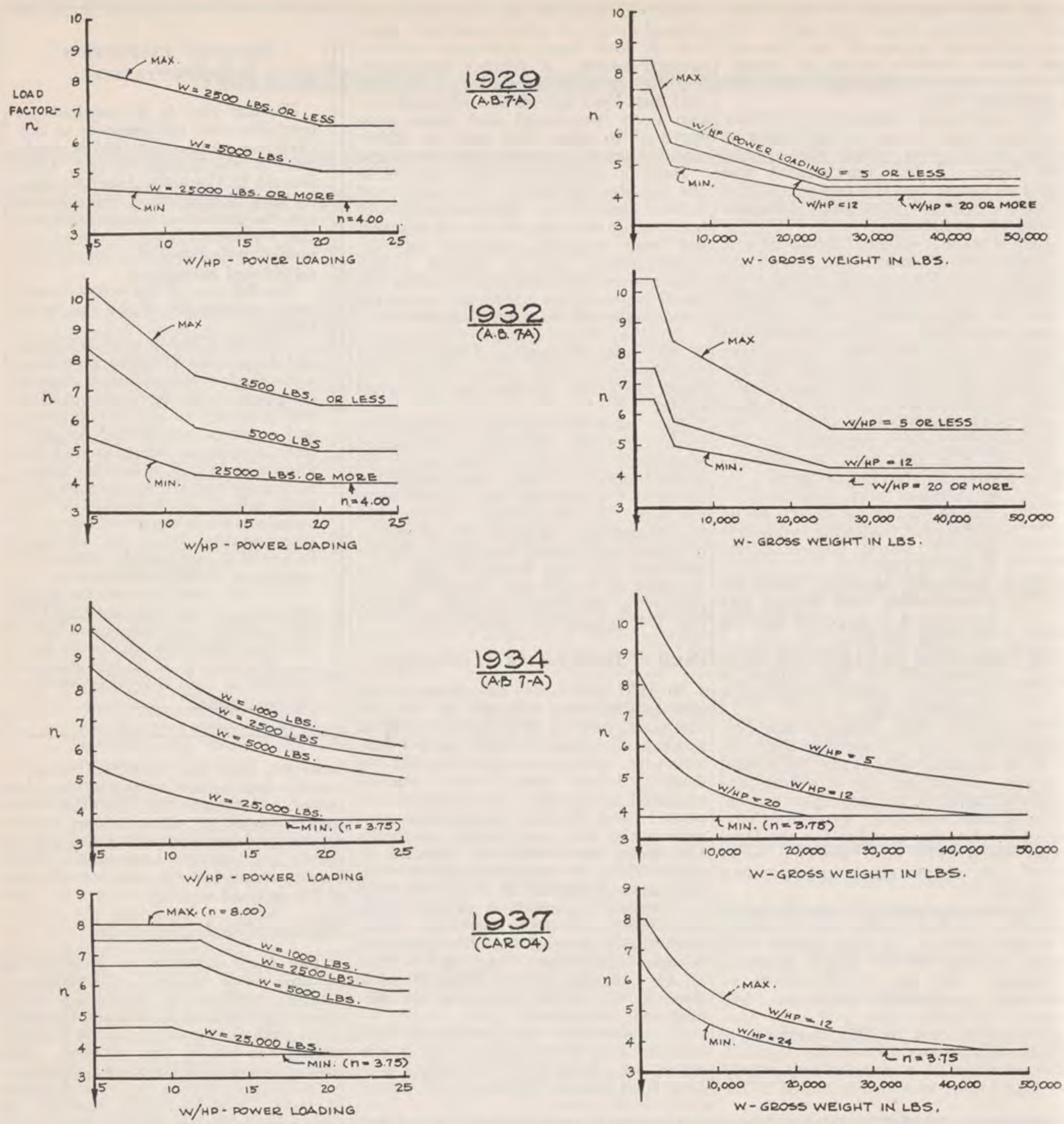

Figure 1.—History of ultimate maneuvering load factors (high angle of attack).

airplane speed. Through the cooperation of the NACA, air carrier operators, and owners of private airplanes the AIRCRAFT AIRWORTHINESS SECTION has acquired a collection of such records covering all types of commercial operation.

From an analytical viewpoint the prediction of *maneuvering* load factors is a complex problem that has been attacked in various ways by different investigators. Omitting some of the earlier papers, the most significant studies were made by J. S. Newell (reference 1) and E. P. Warner (reference 2) in 1931 and 1932. The Department of Commerce also issued several papers during the years 1931 to 1933 (references 3, 4, 5, 6). British and German investigators also wrote papers along similar lines at about the same time.

Most analytical studies emphasize the importance of *speed* in the prediction of maneuvering load factors. The *wing loading* is usually introduced also, either directly, or through the use of the stalling speed. The use of stalling speed in the load factor formula also brings in the *maximum lift coefficient*. It was soon found that the maximum load factor obtainable before stalling is entirely beyond the range of reasonable design practice, unless the speed is kept relatively low. Warner (reference 2) shows that the maximum theoretical load factor obtainable in a pull-up at top speed is of the order of 32. He adds, "Obviously, an airplane designed for that factor would hardly be capable of getting into the air at all, to say nothing of carrying a military or commercial load, and the imposition of even a considerably smaller load would be immediately fatal to the pilot."

The analytical method must therefore introduce some other limitations. This is where most of the difficulty is encountered, as it becomes almost impossible to specify actual values for all the variables that tend to affect the maximum load factor. Among the influences considered by various authors we find, for example, speed, wing loading, piloting force, pilot's discretion, physiological limits, weight of airplane, size of control surfaces, angle of bank, radius of pull-out, stability characteristics, aerodynamic limitations, and so on. In recent years the difficulty of making an accurate analysis to determine maneuvering load factors has been further increased by the general adoption of high-lift devices, automatic pilots, balanced control surfaces, tabs, servo devices, etc. It is largely for this reason that no radical changes in the method of specifying maneuvering load factors have been made in the various revisions of the requirements.

6. Method of Evaluating Present Requirements

Since the primary object of this paper is to discuss the present United States load factor requirements, it is desirable to set up a definite method of procedure, based on the foregoing principles. The discussion therefore will be subdivided along the following lines:

- (*a*) Types of load factor:
  1. Maneuvering.
  2. Gust.
  3. Limit.
  4. Ultimate.
- (*b*) Class of airplane:
  1. Large airplanes.
  2. Small airplanes.
- (*c*) Method of attack:
  1. Statistical.
  2. Analytical.
  3. Operation limitations.
  4. Comparison with other requirements.

In subdividing airplanes as to class, "large" airplanes will be considered as those for which the minimum *limit* load factor of 2.5 applies (3.75 ultimate). From figure 04–3 (CAR 04) this indicates gross weights of 30,000 pounds or more.

Since *gust* load factors can be discussed without particular reference to airplane classes, they will be taken up first. Maneuvering load factors for small airplanes will be covered in Aircraft Airworthiness Section Report No. 8.

7. Gust Load Factors

To avoid a long discussion of the technical background on which gust load factor formulas are based, this subject has been assigned to Aircraft Airworthiness Section Report No. 7, which covers the fundamental principles in a simplified manner. In the present paper we are concerned mainly with the gust condition that determines the maximum load factor. This condition is represented in the present requirements by condition I (CAR 04.2131) which requires positive and negative "effective" gusts of 30 feet per second normal to the flight path, at an airplane speed V_L. This speed is usually interpreted as the maximum speed in level flight, although the designer may choose a higher or lower value. The value chosen forms the basis for speed limitation placards.

Assuming that the speed V_L represents the maximum speed for continuous operation of the airplane, the 30 feet per second gust was chosen as the most severe gust likely to be encountered at any speed up to V_L. From an analytical standpoint it is obviously impossible to determine the actual value to be used in the requirements. We must therefore turn to statistics in estimating the adequacy of present gust requirements.

As pointed out in Aircraft Airworthiness Section Report No. 7, *V–g* (velocity-acceleration) records have been collected for several years and furnish the only reliable method of evaluating gust velocities. References 7 and 8 give composite curves of "effective" gust velocities against airplane speed (reproduced here as fig. 2). These curves are still representative of the state of knowledge on gusts, with the exception of a few isolated cases of somewhat doubtful statistical value. Although there is evidence of "effective" gusts as high as 35 feet per second having been encountered, these all occurred at speeds below V_L. This agrees with the basis on which the requirements were set up. (See also fig. 1 of Aircraft Airworthiness Section Report No. 7.) showing the permissible increase in gust velocity with reduced speed.)

As pointed out in reference 7 and in Aircraft Airworthiness Section Report No. 7, there is reason to believe that airplanes of higher wing loading are more severely loaded by gusts than would be indicated by the original "sharp edged" gust formula. The requirements already include a *reduction* factor (K) for airplanes having wing loadings *less* than 16. (CAR 04.2121) (16 represents an average value at which the statistics were collected.) CAAM 04, Appendix I, B, 3 recommends that the factor K also be used at wing loadings *above* 16, in which case it represents an increase in the effective gust velocity. (See fig. 2, Aircraft Airworthiness Section Report No. 7.) This recommendation was placed in CAAM 04 (instead of being made a revision to the requirements) because of the possibility that further research would disclose a more suitable method of correction.

The Aircraft Airworthiness Section feels that a correction factor of this type should be included as a regular requirement. The present curve for K (in CAAM 04) might be regarded as a satisfactory means of taking care of gradient effect, pending further developments. Eventually the requirements might be put on a more rational basis by specifying a *true* gust velocity together with a single correction factor to account for aerodynamic "lag" and gradient effect.

Due to the lack of complete knowledge of the gust problem, the present requirements probably contain certain "hidden" factors of safety and safe assumptions. For instance, the method of "working back" from statistical records is inherently conservative. Since the *V–g* record covers many hours of flying and shows only maximum acceleration, it is impossible to know exactly at what wing loading these maximum accelerations occurred. The wing loading based on gross weight is therefore commonly used in converting accelerations into gust velocities. Actually, however, the maximum accelerations are most likely to be produced when the airplane is flying at *reduced* weight (acceleration being inversely proportional to weight, for a given gust velocity). As time goes on, we can therefore expect the composite *V–g* envelope to represent conditions approaching the *minimum* operating weight.

The amount of conservatism that might be introduced in this manner can be estimated roughly by assuming that the minimum operating weight is about 75 percent of the gross weight. Accelerations recorded at this reduced weight would yield effective gust velocities one-third greater than they should do. The gust *load* increment computed from this fictitious gust velocity would therefore be one-third too large.

The possibility that our present use of an effective gust velocity of 30 feet per second is somewhat conservative indicates that we may actually be designing for the *maximum* gusts indicated by the *V-g* recorder. Figure 2 shows that the maximum gust velocities are in the order of 35 to 40 feet per second.

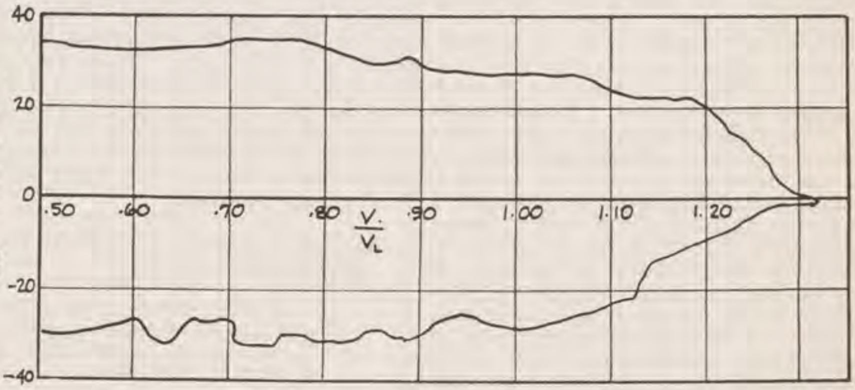

Figure 2.—Effective gust velocities obtained from flight statistics.

If these were actually produced at weights less than gross weight, the corrected values would probably be reduced to approximately 30 feet per second. (A reduction from 35 to 30 would imply a ratio of flight weight to gross weight of 0.86.) It seems reasonable, therefore, to assume that the present requirements are adequate to prevent any structural damage or permanent set *provided* that operations in rough air are confined to speeds *below* V_L.

At present the speed V_L is defined on the airplane placard as the maximum "level flight or climb" speed (formerly "cruising" speed). It would only be necessary to define this speed at a "*maximum rough air speed*" to give it a definite significance which the present placard fails to convey. The need for a restriction to level flight does not seem to be important any longer, as the engine limits are taken care of separately.

Emergency Conditions.—The most unfavorable design condition that can be considered for any airplane would be a combination of circumstances due to loss of control in very gusty weather, requiring a high diving speed for recovery. Under such conditions there is a possibility of striking a gust of relatively high intensity at a speed greater than the design speed (V_L). To include such conditions as a basis for design would increase load factors considerably for all large airplanes and most small ones. A condition of this type should probably be regarded as an *emergency* condition, in which the pilot should be permitted to draw on all the "reserve" factors of safety in the airplane. If such reserve factors of safety are fully utilized, the airplane will be capable of withstanding quite high-gust velocities at speeds considerably in excess of the design speed.

Probably the largest "reserve" factors of safety are caused by the fact that gust load factors are briefly applied (as contrasted to load factors developed in a bank or pull-out). Under such sudden loading conditions it is quite possible that the structure "will not have time" to yield appreciably (reference 10). This means that the *limit* load factor could be exceeded without any damage. In the extreme case the structure might even approach the *ultimate* load without permanent set. This would permit a gust almost 75 percent greater than the design gust (assuming ultimate and limit factors of 4.5 and 3.0). Careful examination of airplane structures after recording high gust load factors have failed to reveal any signs of failure or permanent set. It should also be remembered that any airplane structure is expected to withstand loads up to the ultimate load without complete failure, even under static conditions.

To get an idea of the type of emergency that might be experienced by the structure with little or no damage we can convert the assumed "excess" factors of safety into increases in airplane speed. To do this we will continue to assume that maximum gust likely to be encountered has an effective velocity of 30 feet per second (possibly representing an "actual" gust of 47 feet per second considering gradient effects). (See Aircraft Airworthiness Section Report No. 7.)

Remembering that the gust load factor increment is directly proportional to airplane speed we can find the increase in design speed required to increase the *limit* load factor to the *ultimate* factor. This ratio is given by the required ultimate factor of safety of 1.5. Assuming an ultimate load factor of 4.5 (for large airplanes) the ratio of increments is 3.5/2, indicating an allowable increase of 75 percent in airplane speed. For an airplane having a design speed (V_L) of 200 miles per hour, this would give an emergency speed of 350 miles per hour, at which the airplane might survive gusts of high intensity without breaking, and possibly without even causing permanent set.

(Note.—the exact method of analysis for a particular airplane would consist in determining the "strength" envelope as outlined in Aircraft Airworthiness Section Report No. 5. The above method will give approximately correct results if the gust *load factor* is considered to apply up to the speed $V\text{–}g$, asre commended in Aircraft Airworthiness Section Report No. 4. If torsion loads alone were critical, the allowable $V\text{–}g$ would be increased by $\sqrt{1.75}$ or about 32 percent. This corresponds to speeds 60 to 75 percent above V_L.)

The question of variation of gust velocity with operating speed was discussed in Aircraft Airworthiness Section Report No. 4. For normal operations there is no reason to believe that the present use of a 15-feet-per-second effective gust at maximum design speed ($V\text{–}g$) is inadequate. This question may be affected to some extent, however, by changes in the general design trends or method of operation, particularly if pressurized cabins permit air carriers to operate at greater rates of descent than at present. This is anticipated to some extent by the "simplified" flight diagram (Aircraft Airworthiness section Report No. 4) which provides for higher gusts (at $V\text{–}g$) than at present. The use of a *rough-air* placard would seem to be an even better solution, as it would impose no restrictions on gliding speed except during rough air conditions.

Summarizing the gust load factor situation, the present state of knowledge does not indicate any need for revision of the gust requirements except in connection with gradient effect. The probable errors in analysis methods appear to lie on the safe side. Reserve factors of safety against gusts are probably provided by the structure, permitting emergency operations in rough air at excess speed. For normal operations pilots should reduce the flight speed during gusty weather.

8. Recommendations Concerning Gust Load Factors

(*a*) Revise CAR 04.2121 to include gradient correction factor over the entire range of wing loadings.

(*b*) Change the wording of the present "level flight or climb speed" (formerly cruising speed) placard to "MAXIMUM ROUGH AIR SPEED ______."

(*c*) Accelerate the collection of statistical data.

(*d*) Inform pilots of the limitations of the airplane with respect rough air (i. e., explain the "ROUGH AIR" placard.

(*e*) Examine carefully any structures that have been subjected to high gust load factors in flight.

9. Maneuvering Load Factors (Large Airplanes)

In discussing maneuvering load factors it is almost necessary to differentiate between "large" and "small" airplanes. For this purpose we might consider large airplanes to be those for which the minimum *limit* factor of 2.5 applies. From figure 04–3 (CAR 04) this indicates gross weights of about 30,000 pounds or more. For airplanes in this class the minimum load factor has a constant value of 2.5 *limit*, or 3.75 *ultimate*. Comparing these factors with the corresponding foreign requirements we find, in general, higher ultimate values. British, Dutch, and I. C. A. N. rules specify an ultimate factor of 5. The *limit* factor is considered to be 2.5 (factor of safety=2.0), but proof tests are made to a somewhat higher factor, usually five-eighths of the ultimate. German requirements specify an ultimate load factor of approximately 3.8 for this range of gross weight (the values approach 3.6 as the airplane increases in size.)

Assuming that the gust load factor requirements adequately cover the loads obtained in rough air, the minimum maneuvering load factor seems to be needed mainly to take care of abrupt maneuvers such as a steep bank or sharp pull-up. Obviously such maneuvers are not required in normal flying of airplanes over 30,000 pounds gross weights (to produce an actual load factor of 2.5 in a turn would require an angle of bank of approximately 67°). We do have to consider, however, the possibility of emergency conditions, such as a recovery from loss of control, or a rapid maneuver to avoid a collision. To estimate with any degree of precision just what load factor might be required for such maneuvers is practically impossible. The very nature of an emergency maneuver is such that there is likely to be a wide variation in the load factor produced in different cases and by different pilots.

Under such conditions the question of setting a lower limit for all airplanes must be handled somewhat arbitrarily. The best basis for this seems to be the fact that the pilot will judge the severity of the pull-up largely by the "feel" of the acceleration. This tends to ru'e out any consideration of radius of curvature, wing loading, control loads, etc. The available statistical ($V\text{–}g$) records are not of much value in determining the maximum "pull-up" factors imposed by pilots, as such records do not differentiate between gusts and pull-ups. (From the nature of the records ob-

(*Continued on page 444*)

CIVIL AERONAUTICS BOARD

OFFICIAL ACTIONS

Abstracts of Opinions, Orders, and Regulations

For the Period September 1–15, 1940

Special Notice

Economic Opinions of the Civil Aeronautics Board Available in Printed Pamphlets—Sold Individually or on Subscription Basis

The Civil Aeronautics Journal carries in this section an abstract of all rules, regulations, and orders, and a syllabus of all opinions issued by the Civil Aeronautics Board during the half-month ending 2 weeks prior to the date of publication.

All opinions of the Board in economic proceedings now are printed individually and may be obtained on a subscription basis.

Subscriptions for economic opinions will be by volume rather than for a specific period of time. Each volume will comprise approximately 800 pages of printed opinions which ultimately will make up a bound volume of Civil Aeronautics Board Reports.

For example, opinions issued subsequent to June 30, 1940 (now being printed) are paginated consecutively from 1 to 800, irrespective of the intervals between publication of individual opinions. The same plates used in printing the "advance sheets" later will be used to print the bound volumes.

The first volume of opinions, comprising all decisions of the Civil Aeronautics Authority from the time of its inception to June 30, 1940, when it was transferred to the Department of Commerce, is called Civil Aeronautics Authority Reports, Volume 1. The next volume, of which currently issued opinions will form a part, will be called Civil Aeronautics Board Reports, Volume 2.

Civil Aeronautics Authority Reports, Volume 1, now is being printed, and notice will be given on this page when it is placed on sale.

The subscription price for each volume of "advance sheets" of economic opinions is $1. Remittance should be made to the Superintendent of Documents, Government Printing Office, Washington, D. C.

For those who do not wish to subscribe to the complete volumes, the "advance sheets" of economic opinions may be purchased individually. As each opinion becomes available in printed form, the title of the case, docket number, order number, date, and price will be listed in the Official Actions section of the Journal. All orders must be sent to the Superintendent of Documents.

Opinions in cases of suspension, revocation, or denial or airman certificates are available in mimeograph form only. Verbatim copies of these may be obtained by addressing a request to the Correspondence Unit, Civil Aeronautics Administration, Washington, D. C.

To those persons who now subscribe to the Journal primarily to receive the opinions, and who will so inform the Publications and Statistics Division, Civil Aeronautics Administration, Washington, D. C., will be sent the "advance sheets" of opinions issued up to the date of expiration of their current subscriptions. It should be pointed out, however, that those desiring to receive unbroken sets for each volume should enter their subscriptions for opinions with the Superintendent of Documents now, in order to avoid having their service cut off in the middle of a volume by reason of the termination of their Journal subscription.

Any inconvenience caused subscribers by the change described is sincerely regretted. At the time of the inception of the Journal, however, the altered circumstances which rendered unfeasible the continued inclusion of opinions in the Journal could not be foreseen.

Orders

Order No. 641: *Private pilot certificate of Milam U. Borden, Jr., revoked.*

The Board on August 30 revoked private pilot certificate No. 57907, held by Milam U. Borden, Jr., Columbia, Tex., for piloting an aircraft acrobatically at an altitude less than 1,500 feet and other violations of the Civil Air Regulations. (This order was not received in time for inclusion in the last issue of the Journal.)

Order No. 646: *Directed John O'Connor to show cause why his student pilot certificate should not be suspended or revoked.*

The Board on September 3 directed John W. O'Connor, Estes Park, Colo., to appear before an examiner of the Board and show cause why his student pilot certificate No. 94608 should not be suspended or revoked for piloting an aircraft closer than 300 feet vertically to the base of an overcast or cloud formation, and other violations of the Civil Air Regulations.

Order No. 647: *Commercial pilot certificate of Everett C. Winings revoked.*

The Board on September 5 revoked commercial pilot certificate No. 947 held by Everett C. Winings, Indianapolis, Ind., for piloting an aircraft on a civil airway, carrying a passenger, while under the influence of intoxicating liquor.

Order No. 648: *Reopened hearing in the matter of the petition of Braniff Airways.*

The Board on September 7 reopened the hearing in the matter of the petition of Braniff Airways, Inc., for an order fixing and determining the fair and reasonable rates of compensation for the transportation of mail over routes Nos. 9 and 15 and including in such reopened hearing the matter of determining the rate of compensation for the transportation of mail over route No. 50.

ORDER No. 649: ***Student pilot certificate of Jack Harold Dusenbury revoked.***

The Board on September 10 revoked student pilot certificate No. S-59989, held by Jack Harold Dusenbury, San Gabriel, Calif., for giving flying instruction without being possessed of an instructor rating.

ORDER No. 650: ***United denied motion for extension of time to file petition.***

The Board on September 10 denied the motion of United Air Lines Transport Corporation for extension of time within which to file a petition for reconsideration, rehearing, and reargument of the orders and opinions of the Board fixing and determining fair and reasonable rates of compensation for the transportation of mail over routes Nos. 1, 11, 12, and 17.

ORDER No. 651: ***American granted request to withdraw application for certificate of public convenience and necessity.***

The Board on September 13 granted request of American Airlines, Inc., to withdraw its application for a certificate of public convenience and necessity authorizing air transportation between Cincinnati, Ohio, and Scranton and Wilkes-Barre, Pa., via Pittsburgh, Pa.

Flight Load Factors

(*Continued from page 442*)

tained, the maximum accelerations appear to have been caused almost entirely by gusts.)

About the only evidence available on this subject is the successful operation, for over 30,000 hours, of large flying boats designed to the minimum required maneuvering load factor (2.5 *limit*). This might be used as a basis for retaining the present minimum requirements for flying boats. There is no equivalent background of experience, however, to indicate that the present requirement is adequate for landplanes, as no large landplanes have been designed to the minimum maneuvering load factor (gust factors usually having been higher). In view of this, and considering the possible differences in operation over land and water, it may be desirable to raise the minimum factor for landplanes and amphibians, retaining the present value for (large) flying boats.

Pending further collection of statistics on the actual load factors imposed by deliberate maneuvers, it is proposed (as a matter for consideration by manufacturers) that the minimum values for landplanes (and amphibians) be raised to 3.0 *limit* and 4.5 *ultimate*. This should not appreciably affect any present airplanes and will tend to facilitate reciprocal agreements with foreign countries.

At first sight it may seem that an increase of only 20 percent in load factor would be insignificant as far as increasing the possible maneuvering ability is concerned. Actually, however, the "rapidity" of the pull-up is determined by the load factor *increment*, that is, the acceleration *above* that in steady flight. Assuming level flight, for instance, increasing the *limit* load factor from 2.5 to 3.0 increases the maneuvering acceleration by one-third. This means that the radius of curvature of the pull-up could be reduced to three-quarters of its previous allowable value.

This line of reasoning reveals what is possibly the most important fact in connection with maneuvering load factors, which is that low factors provide very little "extra" acceleration for pull-ups (40 percent of the 2.5 factor being utilized for steady level flight). The high ratio of "continuous" to *ultimate* or *yield* stresses is also a factor to be considered. This point should not be confused with the determination of load factors, however, as it more properly comes under the heading of "factors of safety."

For large airplanes the problem of operating limitations on load factor is quite important, due to the low values required. The use of accelerometers is recommended, not only as a means of indicating dangerous accelerations, but also to help pilots evaluate physical sensations in terms of acceleration. In an emergency pull-up the pilot cannot be expected to keep his eye on the accelerometer, but if he recognizes the "feel" of a 2.5g acceleration he will instinctively prevent the airplane from being overloaded. A better knowledge of the airplane's strength limitations in terms of physical sensation might easily represent the difference between a safe and a dangerous pull-up under emergency conditions. There are, of course, many other methods of informing the pilot of dangerous accelerations, but the use of an accelerometer is at least the first step in this direction.

From a theoretical standpoint, the minimum value of maneuvering acceleration might well be made to depend on the airplane's inherent characteristics. For instance, an airplane can be so designed that it is nearly impossible to pull it up to 3g. On the other hand, a similar airplane might be designed so that the required control force decreased as the load factor increased (a characteristic of some low-wing airplanes). Obviously the probability of developing a high load factor in the second airplane is greater than in the first. Automatic pilots, booster controls, etc., all tend to complicate this problem. Due to the difficulty of predicting the airplane's characteristics, it seems best to omit them from the determination of minimum load factor and to recommend careful consideration of design features or control systems that tend to limit the maximum accelerations to definite values.

Summarizing the foregoing notes on maneuvering load factor for large airplanes the fact that present minimums are relatively low should be regarded as an incentive to *keep* them low as a matter of efficient design. For landplanes a small increase appears desirable, however, to provide a greater range for maneuvering. Further increases in maneuvering load factors do not seem necessary, provided that the possibility of exceeding the ultimate load factor in a pull-out after loss of control is made even more remote by incorporating design features which guard against both loss of control and the development of high pull-up load factors.

10. RECOMMENDATIONS ON MANEUVERING LOAD FACTORS FOR LARGE AIRPLANES

(*a*) Retain the present minimum value (2.5 *limit*) for flying boats.

(*b*) Possibly increase the minimum value to 3.0 *limit* (4.5 *ultimate*) for landplanes and amphibians.

(*c*) Collect more statistics on load factors actually produced (or capable of being produced) by normal and emergency maneuvers (pilots' reports, etc.).

(*d*) Encourage the use of accelerometers as a means of familiarizing pilots with limiting load factors and developing psychological limitations.

(*e*) Encourage designers to incorporate features tending to reduce the probability of developing high pull-up factors. (Possibly by permitting the use of lower maneuvering load factors in such cases.)

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Standardization Center

(*Continued from page 434*)

inspectors are given demonstrations and tests annually at a center specially equipped for this purpose."

Arrangements have been concluded with the city of St. Petersburg to lease the airport, together with the administration building, hangar, and other facilities, on a dollar-a-year basis, Colonel Connolly said.

St. Petersburg was found suitable, he explained, because of its favorable year-round weather; the fact that it has both land and seaplane facilities; and because the city was willing to spend some $70,000 meeting requirements of the center and then lease the plant on a nominal basis.

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