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ARMY AIR FORCES HISTORICAL STUDIES: No. 47

DEVELOPMENT & PROCUREMENT of GLIDERS in the ARMY AIR FORCES

1941 - 1944

The original of this monograph and the documents from which it was written are in the USAF Historical Division, Archives Branch, Bldg. 914, Maxwell Air Force Base, Alabama.

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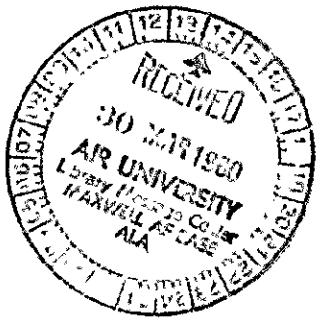

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AAF Historical Office
Headquarters, Army Air Forces
March 1946

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FOREWORD

This study of the development and procurement of gliders for use by the Army Air Forces was prepared in the Air Technical Service Command Historical Office by Lt. Paul M. Davis and Mrs. Amy C. Fenwick.

The history gives a narrative account of the events which led to the beginning of a glider program in the Army air arm, describes the administrative organization for development and procurement, presents a detailed treatment of the experimental and procurement programs for training and tactical gliders, and finally evaluates the glider development and procurement program as a whole for the years 1941 through 1944. Some of the more important documents upon which this study is based have been reproduced and are bound in a separate appendix on file in the Sources and Editorial Division, AAF Historical Office.

Readers familiar with the subject matter are invited to contribute additional facts, interpretations, and suggestions. For this purpose, perforated sheets have been placed at the back of the study. This history will be handled in strict compliance with AR 380-5.

C O N T E N T S

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ILLUSTRATIONS

Charts

Photographs

Development and Procurement of Gliders in the Army Air Forces

1941-1944

Chapter I

INCEPTION OF THE GLIDER PROGRAM

The German Army used troop and cargo carrying gliders in the invasion of Poland in 1939. The following year German combat gliders soared into the Low Countries, and in May 1941 Crete was overrun by some 12,000 German glider-borne troops. The history of gliding became suddenly overshadowed by the hard fact of glider invasions. The story of the study of bird flight and of mythological wax wings lost none of its glamor, and students of flying might still recall the achievements of the pioneers—of Lilienthal, who in 1892 "sailed right over the head of the miller Derwitz...and of his esteemed poodle dog,"[1] of the French sailor Le Bris and his "Albatross," of the English Pilcher and his "Hawk," and of the Americans Chanute, Montgomery, Maloney, Curtiss, and the Wrights. But these men and their deeds of courage and ingenuity belonged to the romance of beginnings; in 1941 what was of far greater concern was the apathy of most of the world during the years that glider training forged smoothly ahead in Germany.

With the coming of the power-driven airplane in 1903, gliding was forced into the background. It is generally conceded that the revival of gliding in Germany in the 1920's was due to provisions of the Versailles Treaty which severely restricted German plane production and aircraft utilization. In 1922 Hermann Goering is said to have

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1. Malcolm Ross, Sailing the Skies, p. 55.

outlined a proposed German glider program to E. V. Rickenbacker. He is quoted as saying:

> Our whole future is in the air. And it is by air power that we are going to recapture the German empire. To accomplish this we will do three things. First, we will teach gliding as a sport to all our young men. Then we will build up commercial aviation. Finally, we will create the skeleton of a military air force. When the time comes, we will put all three together--and the German empire will be reborn.[2]

Glider research was subsidized by the German government in the postwar period,[3] and although there was a certain interest in gliding in other countries, it was in Germany that the sport had its most extensive and advanced development. During the period between the two great wars, the Germans held most of the gliding records for endurance, altitude, and speed.[4] Russia was one of the few countries to offer the Germans serious competition in the development of gliding, and significantly, the Germans were careful to profit by Russian experience.[5]

In 1940 Military Intelligence of the War Department General Staff quoted reliable evidence indicating that the Germans had used gliders in the capture of Fort Eben Emael, Belgium, that glider practice was being carried out on many German airdromes, and that the Germans had already built gliders "in some numbers" and were "prepared to use them for troop and possibly tank transport."[6] In the early part of May 1941 there was further evidence that the Germans were engaged in a vast

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2. E. V. Rickenbacker, Seven Came Through, p. 104.
3. F. A. Magoun and Eric Hodgins, A History of Aircraft, p. 283n.
4. Ibid., pp. 281-83; Archibald Black, The Story of Flying, p. 149.
5. Keith Ayling, They Fly to Fight, pp. 105-06.
6. Military Intelligence Division, WDGS, Military Attaché Reports, England 41791, 8 Nov. 1940, and Hungary 1030, 6 June 1940, in Technical Data Library, Wright Field.

glider program. The United States Military Attaché at Bern reported that glider trials were carried out at Brunswick and Mannheim in March and April 1941, and related that "General Kitzinger told Swiss Staff Officers that the German General Staff attached much importance to the trials of transportation of troops by glider."[7] Twelve days after the submission of the report from Bern, thousands of glider-borne German troops began the spectacular invasion of Crete. Here was the final proof that gliding was more than a Sunday pastime.

While the Germans were acquiring a notable proficiency in the construction and use of the glider as a military instrument, American gliding enthusiasts found little encouragement in official circles. Neither in the War Department in general nor in the Air Corps was there any appreciable sympathy for the ardor of the "glider people"; nor, for that matter, was there any real appreciation of the military value of gliders among the civilian devotees of soaring.

As early as 1922, Glenn Curtiss was constructing a glider which he thought might be useful as a target. Curtiss believed the glider might be towed by a motor boat, then released and fired upon.[8] During the next two years 13 target gliders were actually built at McCook Field, and distributed throughout the service for use instead of the conventional tow targets.[9] Beyond this, however, the Air Service did not go. While acknowledging the "considerable enthusiasm" for gliding in the

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7. Ibid., Switzerland 3903, 8 May 1941.
8. Glenn Curtiss to Chief of Air Service, 5 June 1922, in AAG 452.1A, Gliders.
9. Engineering Division, annual report, FY 1922-23, p. 24; ibid., 1923-24, p. 21.

United States and abroad, McCook Field reported that it was adhering to Air Service policy not to undertake any "large scale" investigations.[10]

By 1930 gliding was still primarily a sport, and when a glider enthusiast invited the Air Corps to participate in a national glider meet at Elmira, N. Y., the Assistant Secretary of War replied that "there exists no appropriation whereby an officer on the active list could be dispatched to a duty such as you mention."[11] The following year the Secretary of War said: "It is considered that the military value of glider flying is negligible, and that the expenditure of time and funds required to teach the art is not warranted."[12]

As late as 1938 the War Department was not convinced that the glider had any real value as a military weapon. Harry Malcolm of Lombard, Ill., suggested in August 1938 that gliders might be utilized to carry bombs or troops or they might be built as aerial torpedoes. Military officials dismissed the idea by pointing out that an equivalent load could be carried more efficiently by the towing plane. Malcolm was informed that "the plan of your suggested method of towing gliders as practical weapons is not of sufficient military value to warrant further consideration and development."[13]

Even after the initial German successes with gliders in the war had aroused a new interest in gliding in the United States, the Air Corps was not in a position to accede to the more vehement proposals of

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10. Ibid., FY 1922-23, p. 24. Gliders are not mentioned in the annual reports for 1924-25 and 1925-26.
11. F. Trubee Davison, AS/W to M. C. Eaton, 24 Sep. 1930, ibid.
12. S/W to Gale H. Stalker, House of Representatives, 14 Feb. 1931, in AAG 373A, Glider Flying.
13. Harry Malcolm to S/W, 30 Aug. 1938, and Lt. Col. M. F. Davis to Malcolm, 13 Oct. 1938, in AAG 452.1A, Gliders.

soaring zealots because of the urgent military demands for powered aircraft and airplane pilots.[14] As evidence of German military use of gliders accumulated, however, the Air Corps began to develop a positive glider policy. In February 1941 the Air Corps found that "in view of certain information received from abroad" it was "advisable that a study be initiated with a view to developing a type of glider that can be towed by aircraft."[15] General Arnold personally directed the initiation of such a study on 25 February, and requested the submission by 1 April 1941 of a statement on proposed military glider characteristics and towplanes.[16] The machinery for glider development was officially set in motion by two Classified Technical Instructions, CTI-198, 24 February 1941, and CTI-203, 4 March 1941. These instructions authorized the preparation of design studies and the procurement of 2-, 8-, and 15-place gliders and associated equipment.[17]

The rapidity with which the Air Corps became convinced of the existence of an urgent need for gliders was indicated in the decision to procure gliders before the completion of design studies. On 8 March 1941 preliminary engineering requirements for 15-place gliders were sent to 11 companies. Of these 11, only four submitted favorable replies to Wright Field. Nevertheless, before the completion of the design study report in May, the Air Corps had ordered experimental models of 2-place

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14. AAF Historical Studies: No. 1, The Glider Pilot Training Program, 1941 to 1943, pp. 2-3.
15. R&R, Plans Div. to Exec., MD, 18 Feb. 1941, in AAG 452.1A, Gliders, quoted in ibid., p. 2.
16. Memo for Maj. Gen. George H. Brett, Acting C/AC, by Maj. Gen. H. H. Arnold, DC/S for Air, 25 Feb. 1941, in ATSC 452.1, Gliders, General, 1941-42.
17. Glider Report (6 vols., 10 parts) Nov. 1943, prepared by Proc. Div., MC, WF, in response to TT AFDMA-5-196, Col. W. F. Volandt, Chief, Proc. Br., MM&D, to CG, MC, 8 Aug. 1943, Vol. I, p. 22. [Cited hereafter as "glider report."]

commercial gliders for training purposes and static and flight test models of 8- and 15-place cargo-type gliders.[18]

Results of the Materiel Division's design study were reported in its Memorandum Report EXP-M-51/AD833, 19 May 1941.[19] The Materiel Center first conceived the 8- and 15-place gliders as craft having a towing speed of 120 miles per hour, maximum stalling speed without flaps of 30 miles per hour, and a normal towing altitude of 12,000 feet. The 15-place model was to be designed for a useful load of 3,800 pounds, while the 8-place glider would be capable of carrying a useful load of about one-half that of the larger craft.[20]

The development and production of these gliders was destined to become a major effort of the Army Air Forces, and in the organizations existing and created to perform these functions personnel who were experienced in gliding activities were employed wherever possible. In October 1941 Lewin B. Barringer (later Major) was made coordinator of the glider program. In May 1942 he was assigned to the Office of the Director of Air Support, where he served until January 1943--during which month he was lost when a plane in which he was flying disappeared over the Caribbean.[21] Barringer played a vital part in the glider program. An official of the Materiel Division had observed in January 1942 that Barringer "swings a pretty big stick merely by virtue of being General Arnold's man."[22]

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18. MD Memo Rept. EXP-M-51/AD830, Add. No. 18, 9 June 1941, in ATSC 452.1, Gliders, General, 1941-42.
19. Ibid.
20. "Glider Report," Vol. I, p. 24.
21. Glider Pilot Training Program, p. 9.
22. Phone transcript, Lt. Col. B. W. Chidlaw, Experimental Engineering Br., MD, Wash., and Lt. Col. F. O. Carroll, Chief, EES, WF, 24 Jan. 1942, in ATSC 452.1, Gliders, General, 1941-42.

On 19 April 1943 the Washington organization for gliders was redefined with the establishment in Headquarters, AAF, of an Office of the Special Assistant on the Army Air Forces Glider Program. The Special Assistant was to report to the Commanding General, AAF, through the Chief of Air Staff, and was assigned the authority of an Assistant Chief of Air Staff in matters relating to the glider program.[23] On 20 April Richard C. duPont was named Special Assistant to the Commanding General, AAF, in charge of the Army Air Forces Glider Program.[24] Five months after his appointment to this post, duPont was killed in a glider crash[25] and his brother, Maj. Felix duPont, was named to succeed him.[26]

In November 1943 the functions of the Special Assistant on the Glider Program were transferred to appropriate offices of Headquarters, AAF, and a Glider Branch was set up in the Requirements Division, Assistant Chief of Air Staff, Operations, Commitments, and Requirements (OC&R). Maj. Felix duPont became chief of the new branch on 5 November 1943.[27]

Decisions of the glider authorities and officials of the Air Staff were transmitted to the materiel organization at Wright Field through the Materiel Division, Washington. At Wright Field the development of gliders was a function of the Aircraft Laboratory, a part of the Experimental Engineering Section (EES). The glider organization of the

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23. AAF Memo No. 20-3, 19 April 1943.
24. Memo for Richard C. duPont by Gen. Arnold, 20 April 1943, in Report, Army Air Forces Glider Program, Production Procurement, 1 May 1942 to November 1943, by Lt. Col. E. W. Dichman, copy in ATSC Hist. Office. [Cited hereafter as "AAF Glider Prog., Prod. Proc."]
25. See pp. 46-47.
26. TT AFDMA-1-243, AC/AS, MM&D to CG, MC, Attn. Tech. Exec., 9 Oct. 1943, copy in "AAF Glider Prog., Prod. Proc.," app. P.
27. AAF Memo No. 20-3, 5 Nov. 1943; "Glider Report," Vol. I, p. 21.

Aircraft Laboratory was placed under the supervision of Maj. Fred R. Dent, Jr. In January 1942 it was decided that EES should also retain the function of glider procurement until such time as sufficient development work had been completed to make feasible a separation of the experimental and procurement functions.[28] The progress of the development work on gliders soon justified such a delineation, and on 11 May 1943 the administration of the glider production program was transferred to the Production Engineering Section (PES), Production Division. Maj. Ernest W. Dichman, formerly associated with Vought-Sikorsky, took charge of production as head of the Glider and Miscellaneous Aircraft Branch of PES. He was assisted by Lt. Daniel E. Riley. Colonel Dent and his staff in the Aircraft Laboratory remained in charge of all experimental gliders and of technical matters concerning production gliders.[29] The glider testing activities of the Aircraft Laboratory were supervised at Wright Field by the Flight Research Unit of the Glider Branch. In July 1943 the Research Unit was transferred to the newly built Clinton County Army Air Field near Wilmington, Ohio.[30] Here at a base designed for the accommodation of gliders the Materiel Command carried on many of the research and testing projects essential to the success of the glider program.

It was well that plans were made early in the glider program for

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28. "Glider Report," Vol. III, Pt. 1, pp. 30, 33, 34.
29. TT EXP-T-1390, Tech. Exec., Mat. Cent. to CG, MC, Wash., 15 May 1942, in ATSC 452.1, Transport Gliders, 1942-43-44; IOM, Col. T. A. Sims, Asst. Tech. Exec., Mat. Cent., to Col. B. W. Chidlaw, Exp. Eng. Br., MC, Wash., 26 May 1942, in ATSC 452.1, Glider Program, General, 1942-43.
30. Airc. Lab. Weekly TT (to Hq. AAF), 9, 16 July 1943, in Airc. Lab., Eng. Div., ATSC.

the establishment of a sound organization for the dispatch of the task ahead. From its unimposing beginnings in February 1941, when the Air Corps found it "advisable that a study be initiated," to the strenuous days of November 1944 the glider program was expanded until it called for the procurement of approximately 18,000 gliders. This procurement involved the award of contracts for quantities of some 37 experimental models to 23 companies in 10 states, and the letting of contracts for 11 production models to 22 companies in 14 states. From this major development-production effort came the AAF gliders flown in Burma, France, and Holland. There is an element of paradox in the fact that much of the drama of Normandy and Arnhem had its origin in a glider program beset by seemingly endless difficulties.

Chapter II

THE EXPERIMENTAL PROGRAM: TRAINING GLIDERS

Upon the initiation of the glider program it was apparent that there was an urgent need for glider pilots and training gliders. The Air Corps foresaw the task of training pilots for test and further training work in the coming program, but faced the fact that there were not sufficient gliders readily available for even these initial needs. As a result, the provision of training gliders became the first urgent development and production job of the glider program.[1]

Because of the urgency of the training program, and in view of the availability of commercial type gliders, the Materiel Division was guided in its procurement of training gliders by the requirements and certification policies of the Civil Aeronautics Administration (CAA) rather than by a prepared type specification. Gliders which had earned or appeared likely to earn an approval certificate of the CAA were considered for procurement.[2]

The policy of granting fixed-price contracts for the great majority of experimental gliders was established early in the glider program by officials of the Glider Branch, Aircraft Laboratory.[3] It was deemed advisable to utilize the safeguard of this type of contract as a

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1. See Glider Pilot Training Program, Chap. I.
2. Interview with Maj. William C. Lazarus, Actg. Chief, Glider Br., Airc. Lab., 7 Dec. 1944, typescript in ATSC Hist. Office.
3. All subsequent references to the Glider Branch are to that in the Aircraft Laboratory, Wright Field, unless otherwise indicated.

protection against greatly excessive costs possible in a program which by necessity turned to inexperienced or small companies for the manufacture of gliders. Later events were to prove that this policy imposed severe financial problems on some companies, but its value to the Government as a protective measure was not denied.[4]

Frankfort XTG-1

Within two months after the formal initiation of the glider program the Materiel Division at Wright Field had issued an Authority for Purchase for the procurement of three 2-place gliders of commercial design. This Authority for Purchase resulted in contract W 535 ac-19150 (Purchase Order 41-10293), 26 May 1941, with the Frankfort Sailplane Company of Joliet, Ill. The three experimental gliders purchased on this contract were given the Air Corps designation XTG-1, and were procured at a total cost of $5,784.99.[5] The first article on the contract was delivered to Wright Field on 29 September 1941,[6] and the contract was completed in March 1942.[7] A modified XTG-1 was approved as a training glider for the AAF, and in May 1942 the Frankfort Company was awarded a production contract for the TG-1A.[8]

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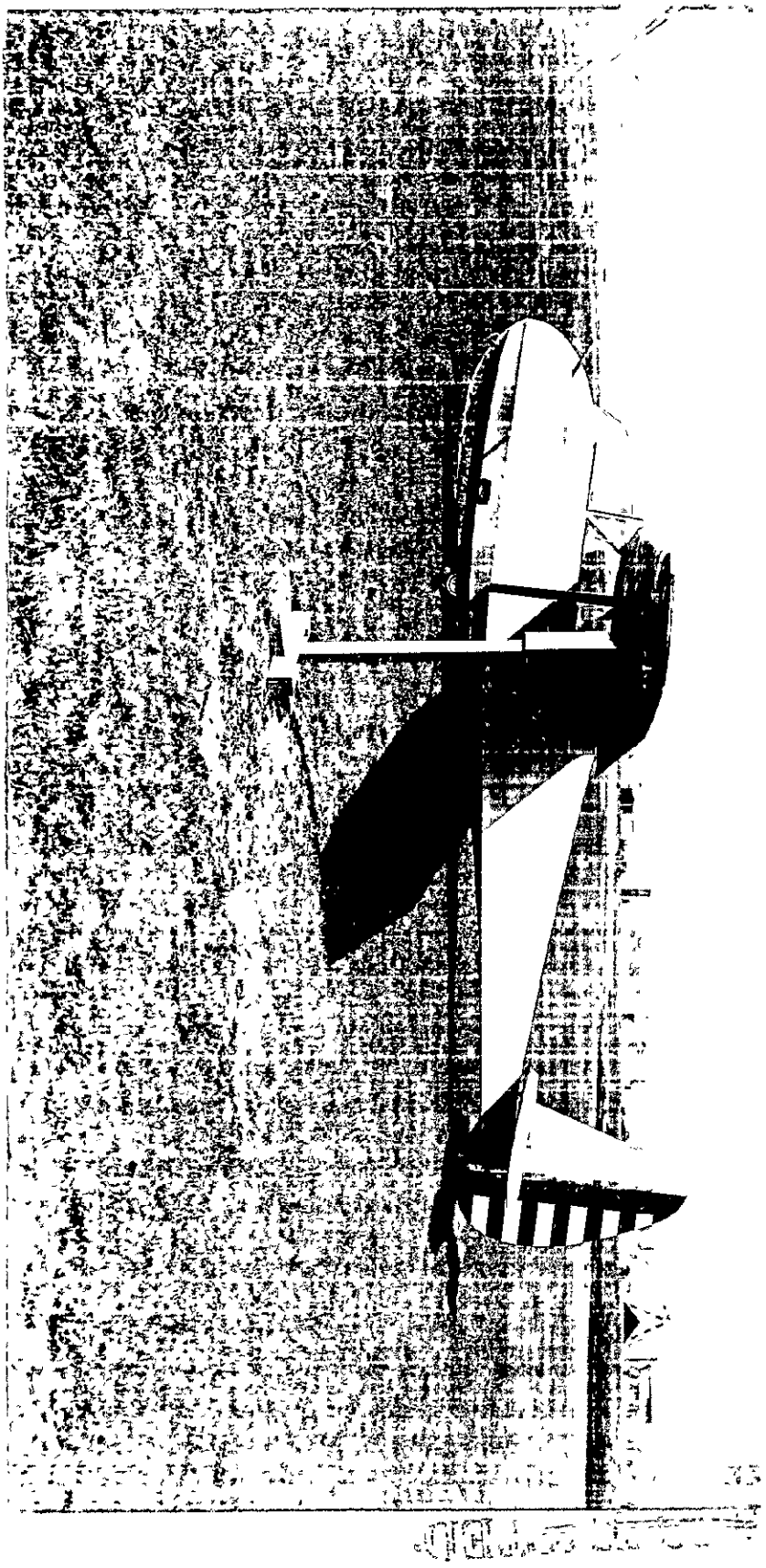
4. Ibid. See contracts for experimental gliders, in Contract Files, Proc. Div., ATSC.
5. MD Memo Rept. EXP-M-51/AD830, Add. No. 18, 9 June 1941. Cost data is from Kardex Cumulative File of Payments, Finance Section, Budget and Fiscal Office, ATSC. [Hereafter cited as "Finance Sec. File of Payments."] All total cost figures used in this study represent payments to 31 October 1944.
6. Arc. Lab. Weekly TT, 2 Oct. 1941.
7. "Glider Report," Vol. III, Pt. 1, p. 126.
8. Contr. W535-ac-28131. The addition of the letter "A" to the model designation used in the experimental contract indicates that certain modifications of the experimental model were made by the Glider Branch of the Aircraft Laboratory.



Frankfort XMG-1

Schweizer XTG-2

On 27 June 1941 contract ac-20021 (Purchase Order 41-11887) was approved[9] calling for the delivery of three 2-place training gliders by the Schweizer Aircraft Corporation of Elmira, N. Y. This glider was known as the XTG-2.[10] Deliveries were completed in September 1941,[11] and the following month the company was awarded a production contract for a small number of TG-2 gliders.[12] The three experimental models cost the Air Corps $6,477.45.[13]

Laister-Kauffmann XTG-4

While tests of the XTG-2 were in progress, negotiations were under way for procuring additional training gliders from the Laister-Kauffmann Aircraft Corporation of St. Louis. Contract ac-21757 (Purchase Order 42-3715) with this company was approved 8 October 1941. Laister-Kauffmann agreed to furnish four models of an XTG-4 2-place trainer for $10,045.[14] A static test article was delivered on 27 December 1941;[15] the remaining deliveries were not completed until a year later.[16] The final contract price was $10,404.[17] After a flight test article XTG-4, delivered in February 1942,[18] proved satisfactory for production procurement, a quantity order was placed for TG-4A gliders.[19]

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9. Contracts were approved by the Chief, Procurement Division, the CG, MC, or the Office of the Under Secretary of War, depending upon the amount of the contract.
10. "Glider Report," Vol. III, Pt. 1, p. 128.
11. Airc. Lab. Weekly TT, 31 July, 11, 25 Sep. 1941.
12. Contr. W535 ac-21942.
13. Finance Sec. File of Payments.
14. "Glider Report," Vol. III, Pt. 1, p. 127.
15. Airc. Lab. Weekly TT, 1 Jan. 1942.
16. "Glider Report," Vol. III, Pt. 1, p. 127.
17. Finance Sec. File of Payments.
18. Airc. Lab. Weekly TT, 26 Feb. 1942.
19. Contr. W535 ac-25850.

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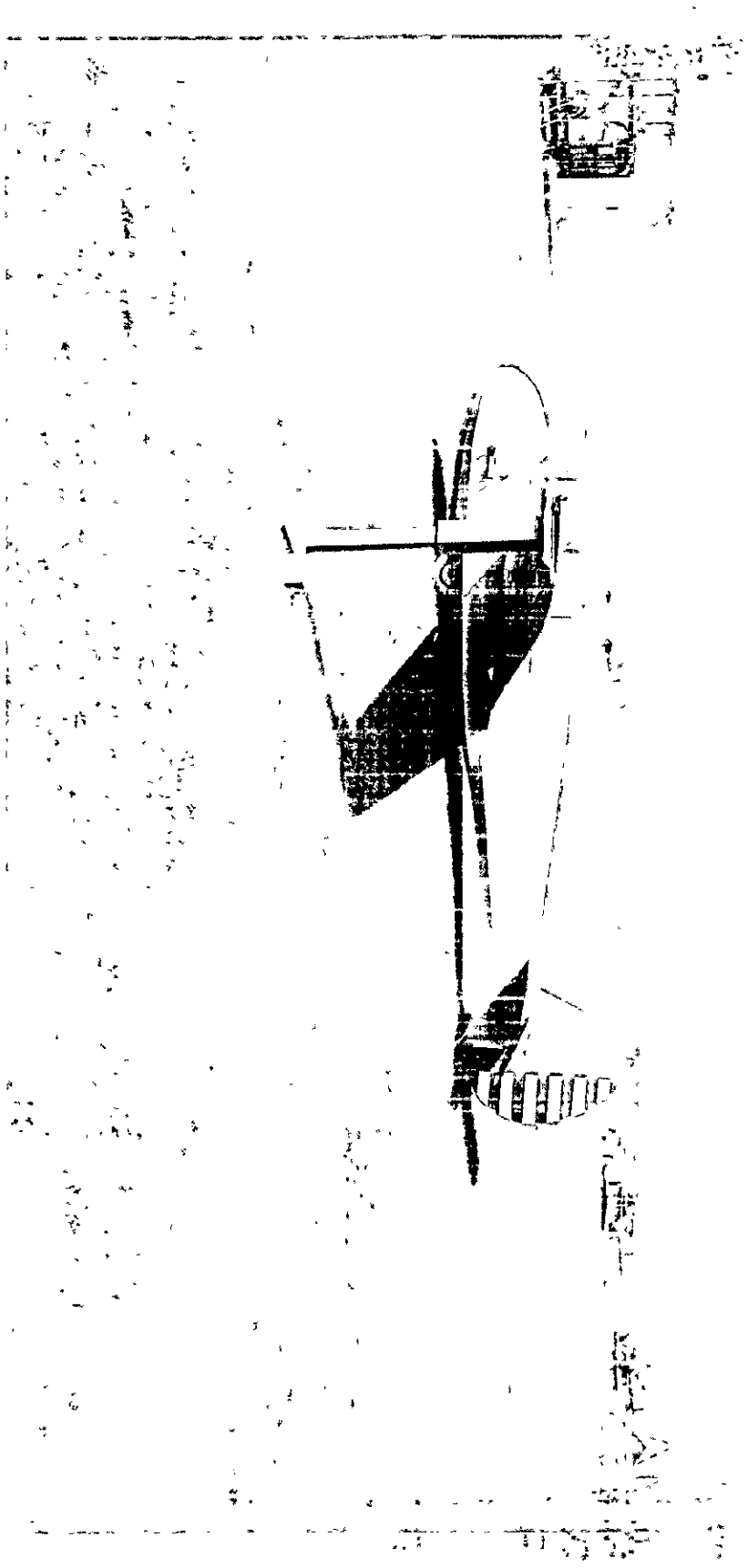
Schweizer TG-2



Laister-Kauffmann XTG-4

Schweizer XTG-3

The Schweizer Aircraft Corporation was awarded a second contract for an experimental glider in October 1941. Contract ac-22074, approved 29 October 1941, called for the delivery of four 2-place trainers, under Air Corps designation XTG-3.[20] A static test article was delivered on 5 March 1942,[21] and the contract was completed four months later.[22] The total cost of the XTG-3 gliders was $13,209.[23] Three weeks after the delivery of the static test model XTG-3, a production contract for the TG-3A glider was approved.[24]

Bowlus XTG-1

For approximately six months after the award of the Schweizer XTG-3 contract there was no new procurement of experimental gliders. Early in 1942 the Glider Branch was interested in securing a standard model of a tandem type, all-wood training glider.[25] Bowlus Sailplanes, Inc., of San Fernando, Calif., was given a contract (ac-28290, Purchase Order 42-17694) for four test models of such a glider. The contract was approved on 28 April.[26]

By December 1942 Bowlus had made no deliveries, and on 15 December a Bowlus executive notified the Materiel Center that the company was in desperate financial straits. Bowlus officials claimed they had already spent $68,000 on a contract bearing an original contract price of $14,000.[27]

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20. "Glider Report," Vol. III, Pt. 1, p. 129.
21. Airc. Lab. Weekly TT, 5 March 1942.
22. "Glider Report," Vol. III, Pt. 1, p. 129.
23. Finance Sec. File of Payments.
24. Contr. W535 ac-26238.
25. Airc. Lab. Weekly TT, 2 July 1942.
26. Contr. W535 ac-28290.
27. Bowlus Sailplanes, Inc., to Chief, EES, 15 Dec. 1942, in Corres., Contr. ac-28290, Contr. Files, ATSC.

Schweizer XTG-3

In addition, Bowlus claimed that "considerable and unexpected delays were encountered due to draft, or forced enlistment, of certain key people" among plant personnel. In January 1943 company officials pointed out that the Army offered them no prospect of a production order, and, insisting that the company was nearly bankrupt, said "we hereby throw ourselves upon the mercy of Materiel Center for some sort of a just settlement."[28] In February the Aircraft Laboratory at Wright Field pointed out that the Flying Training Command did not anticipate an additional requirement for 2-place training gliders, and requested that negotiations be started for a cancellation of the contract "on an equitable basis."[29] No deliveries were made on the contract, and on 5 August 1943 the contractor was notified of its cancellation.[30] Total payments to the contractor on the XTG-12 project were $10,031.25.[31]

Wichita Engineering XTG-10

While Bowlus was unsuccessfully attempting to construct an XTG-12 glider, the Wichita Engineering Company of Wichita Falls, Tex., was at work on an XTG-10, a 2-place, side-by-side standard wood construction training glider.[32] The contract for this model was approved on 25 June 1942.[33] Almost a year later, on 6 April 1943, after having been unable to make any final deliveries of articles acceptable to the Materiel Center,[34] the company expressed a desire to have the contract terminated

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28. Bowlus to Mat. Cent., 13 Jan. 1943, in Corres., Contr. ac-28290, Contr. Files, ATSC.
29. ICM, Airc. Lab. to Airc. Proc. Br., Proc. Div., Mat. Cent., 17 Feb. 1943, quoted in "Glider Report," Vol. III, Pt. 1, p. 211.
30. "Glider Report," Vol. III, Pt. 1, p. 213.
31. Finance Sec. File of Payments.
32. Airc. Lab. Weekly TT, 2 July 1942.
33. Contr. W535 ac-30527 (Purchase Order 42-22711).
34. "Glider Report," Vol. III, Pt. 1, p. 130.

in order that its facilities might "be used in more essential war production." Three weeks later the company claimed it had spent $47,111.21 on the contract as of 1 March 1943, and asked for an increase in the contract price from $10,500 to $65,000. The following day Wichita was notified that the government no longer needed the articles called for in the contract and was directed to stop work at once.[35] Negotiations pertaining to a settlement of the contract were carried on until near the end of the year. In November 1943 the termination proceedings were completed by a supplemental agreement to the contract calling for a payment to Wichita of $8,500.[36]

Briegleb XTG-13

In June 1942 the Briegleb Sailplane Corporation of Beverly Hills, Calif., was given a contract for three XTG-13 gliders.[37] Like the XTG-12, the XTG-13 was to be a tandem type, all-wood training glider.[38] Briegleb was not able to deliver a flight test article until November 1942,[39] several months after the estimated delivery date agreed upon when the contract was signed.[40] With the delivery of the first article, Briegleb began a movement to have the contract renegotiated and pointed out that they were accumulating costs far in excess of the contract price of $9,000. Negotiations were soon in progress with a view to cancellation

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35. Wichita Engineering Co. to Maj. Bruce B. Price, Airc. Lab., 6 April 1943; Wichita to Chief, Proc. Div., WF, 26 April 1943; Legal Br., Proc. Div., WF to Wichita, 27 April 1943, all quoted in "Glider Report," Vol. III, Pt. 1, p. 282.
36. P.O. 42-22711, in Contr. Files. Finance Sec. File of Payments shows the payment completed.
37. Contr. W535 ac-30563 (PO 42-22814).
38. Airc. Lab. Weekly TT, 2 July 1942.
39. Ibid., 20 Nov. 1942.
40. "Glider Report," Vol. III, Pt. 1, p. 125.

of the contract, and on 8 February 1943 Briegleb was notified that the contract had been terminated for the convenience of the government.[41] Two days later the contractor notified the Materiel Center that he had spent approximately $28,000 to date in the manufacture of the three gliders.[42] The Materiel Center paid the contractor $3,000 for the glider and accompanying trailer delivered in November 1942, and Briegleb was able to sell the two remaining uncompleted articles to a private purchaser for the sum of $6,000. It was the view of the Contracting Officer that the Materiel Center had met its obligation to the contractor as required by the terms of the contract. Officials of the corporation insisted that they should be compensated in full for their loss on the contract and appealed the case to the War Department Board of Contract Appeals. In September 1943, the Board of Appeals held that the contract as drawn specifically prohibited the Contracting Officer from authorizing payments in excess of the contract price, and on that basis denied the contractor's appeal.[43]

The negotiations pertaining to termination of the Briegleb contract illustrated a number of factors important in a consideration of policy with respect to experimental contracts. In March 1943 an official of the Briegleb corporation pointed out that the high costs of development work "in the ordinary course of events would have been amortized over the term of a subsequent quantity order."[44] That the Materiel Center

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41. Ibid., p. 217.
42. Briegleb Sailplane Corp. to Contracting Officer, Mat. Cent., 10 Feb. 1943, quoted in "Glider Report," Vol. III, Pt. 1, p. 217.
43. "Law Library Bulletin," Office of the Judge Advocate, MC, AF, week ending 11 Sep. 1943, quoted in "Glider Report," Vol. III, Pt. 1, p. 222.
44. Briegleb to Mat. Cent., 11 March 1943, quoted in ibid., p. 220.

[redacted] RESTRICTED SECURITY INFORMATION

was aware of a degree of validity in such a view was suggested in an Aircraft Laboratory statement which pointed out that Briegleb was informed that "the purchase price was not sufficient to take care of all engineering and development costs of such a glider." It was further explained to the contractor that "there was a highly competitive market for training gliders and that no production could be assured."[45] Available records pertaining to the XTG-13 contract give no evidence that the contractor denied the existence of such an understanding. Statements of the contractor during the conduct of termination negotiations make it appear that the Briegleb corporation was gambling on the award of a production contract, or in lieu of that, on the generosity of the government.[46] When neither of these favorable circumstances materialized, the contractor found himself stranded, with the experience and perhaps some accomplishment on a design suitable for commercial use as his only gain. When the Materiel Command sought information from Briegleb in September 1943 for use in the Procurement Division's Glider Report, it is hardly surprising that the replies evidenced a great deal of resentment. On 14 September an official of the company (reorganized as the Sailplane Corporation of America) said: "If your continued requests for information are being issued on the assumption that . . . we have a profit to show for our efforts to cooperate in the Army glider program, please correct that and relieve us of the additional expense of reviving a subject we would prefer to forget." The following day the corporation

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45. IOM, Airc. Lab., Mat. Cent., to Contr. Sec., Mat. Cent., 4 Dec. 1942, quoted in ibid., p. 215.
46. See correspondence quoted in "Glider Report," Vol. III, Pt. 1, pp. 215-22.

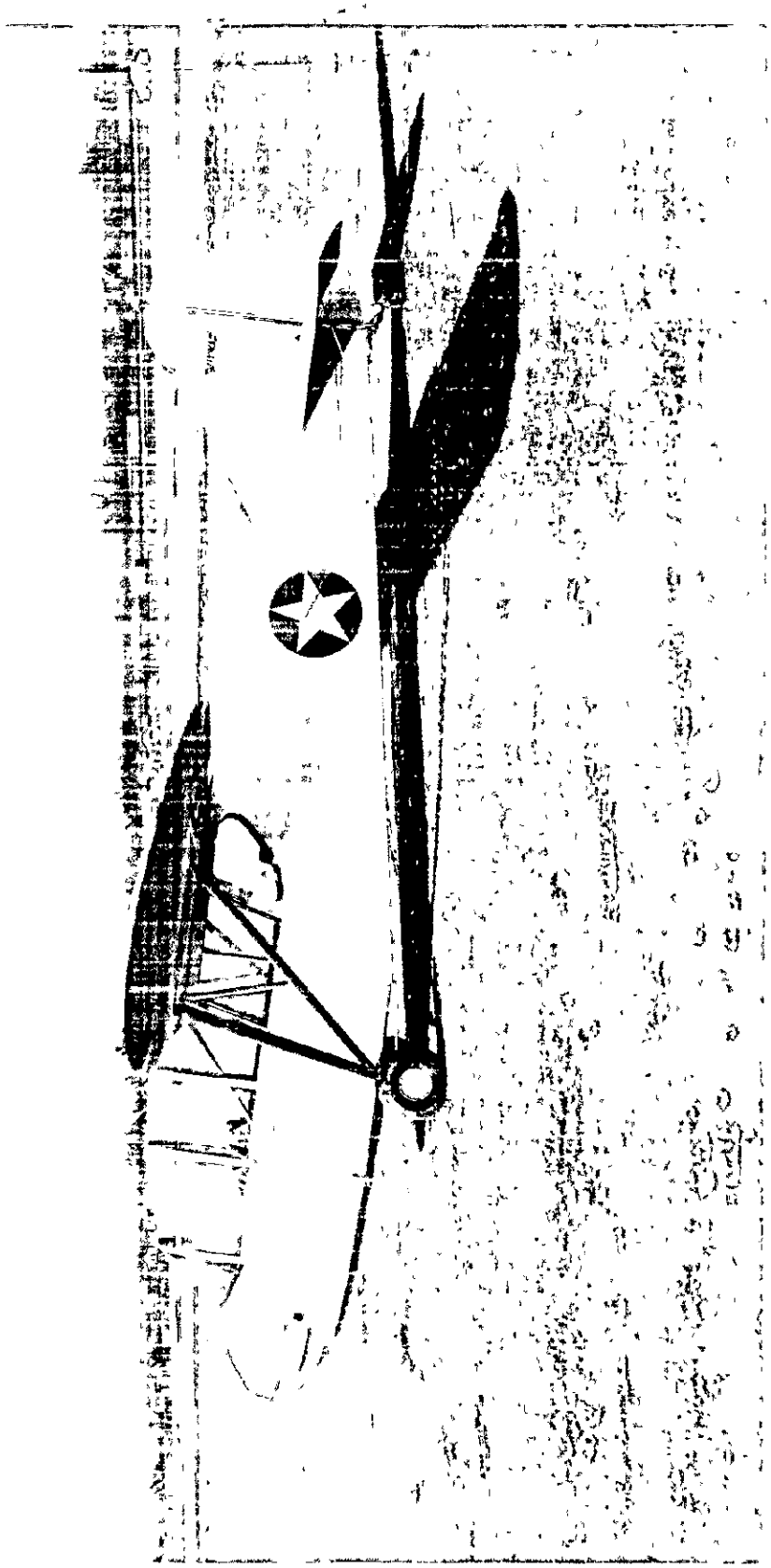
wrote, "please be advised for the tenth time that our contract 42-22814 was terminated for Government convenience on February 8, 1943 . . . ." And two days after this, the firm summarized its view of the matter as follows: "In an effort to meet the need for gliders, financing was obtained, a plant equipped, labor engaged, and an experimental contract accepted on the theory that the Army knew what they wanted. Net result, $30,000 loss."[47] The company's animosity was stimulated by the receipt of the Procurement Division's requests dated 7, 8, 9, 10, and 11 September.[48] But it is clear that without that added irritation, the ill will engendered by the contract-termination settlement was definite.

Aeronca XTG-5, Taylorcraft XTG-6, and Piper XTG-8

As the scope of the glider pilot training program increased in 1942 it became apparent that the requirements for training gliders were far in excess of existing production capacity. At this time the Army Air Forces proved the feasibility of achieving rapid production of training gliders by removing the engine from the cub type of light commercial airplanes. In the late summer of 1942 three 3-place experimental training gliders of this type were secured from each of the following companies: Aeronca (XTG-5), Taylorcraft (XTG-6), and Piper (XTG-8).[49] Production gliders were procured on the same contracts, and the rapidity with which they were delivered, as well as the effectiveness and utility of the gliders in training activities, made this conversion

47. IOM, Maj. Walter F. Zwick, Area Representative, Metropolitan Area, Los Angeles, Calif., to CG, MC, Attn. Chief, Proc. Div., 23 Sep. 1943, and attached letters, Sailplane Corp. of America to MC, 13, 14, 15(2), 17, and 22 Sep. 1943, in Control Sec., Proc. Div., WF.
48. Ibid.

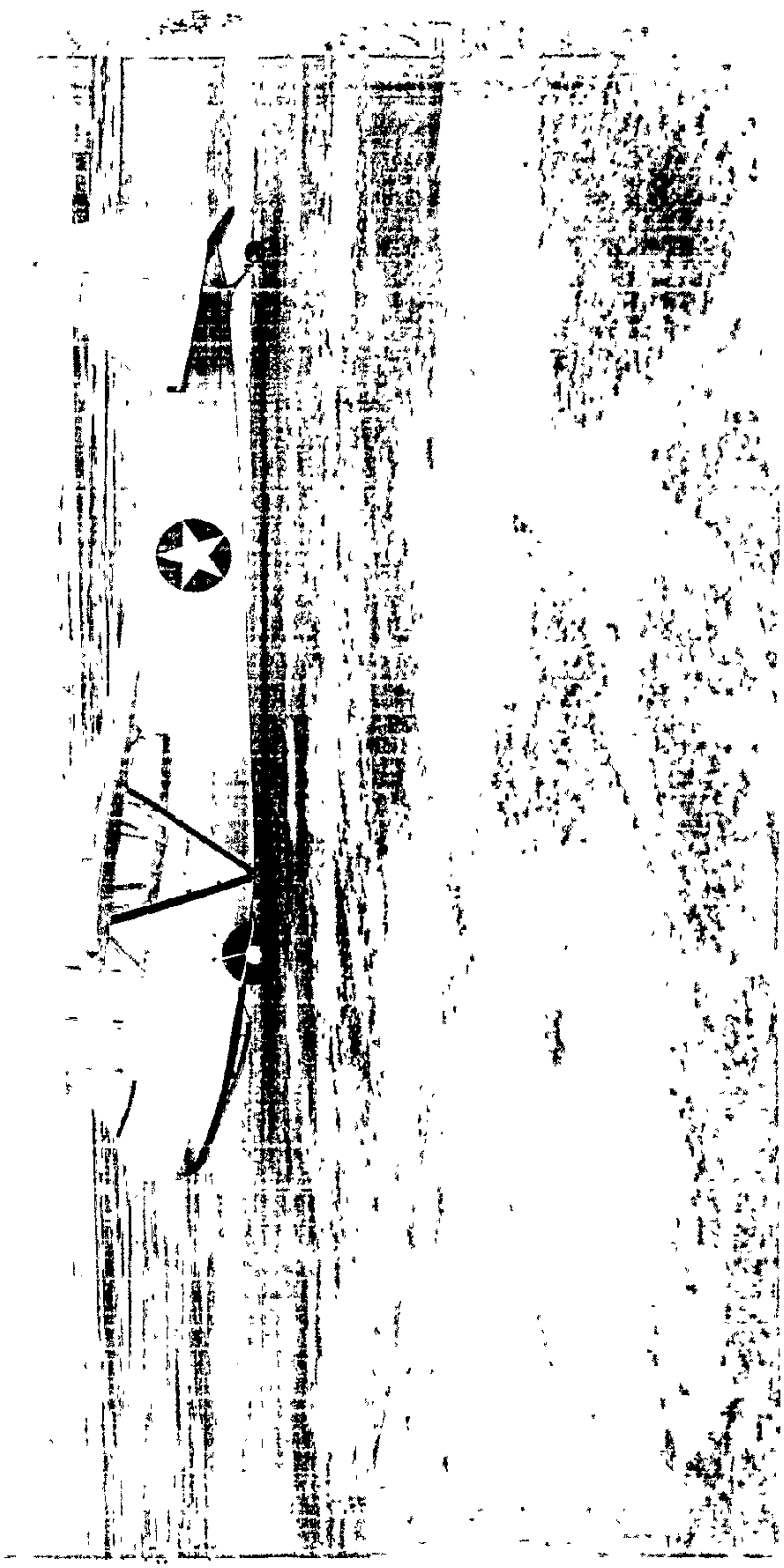
105-34



Taylorcraft XTG-6

Aeronca XTG-5

106[illegible]77



Piper XTG-8

Foreign Gliders

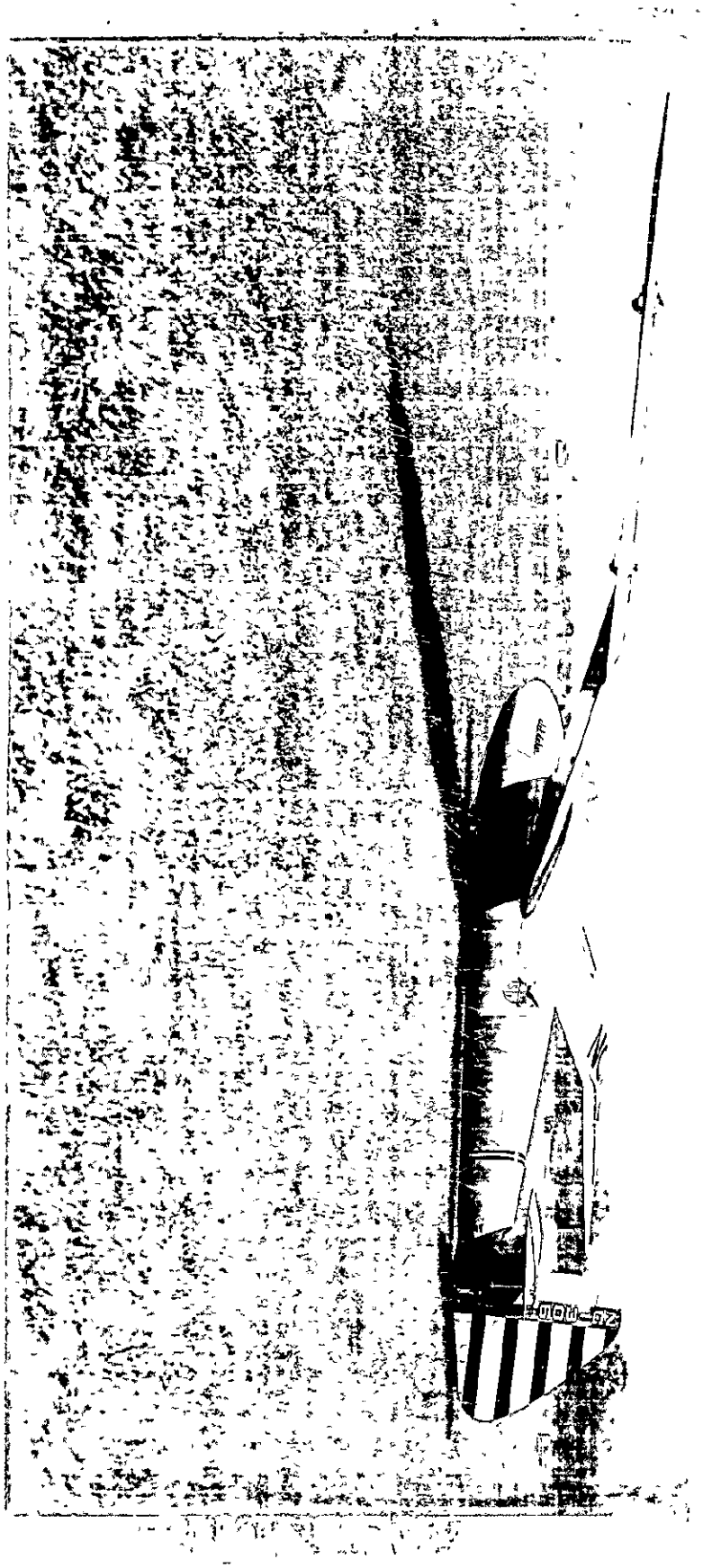
In addition to the experimental training gliders procured as possible production articles, two gliders of foreign design were bought in September and October 1941 from private owners for examination and tests by Materiel Center glider personnel. These were an "Orlik" model Polish-built glider (Air Corps XTG-7) purchased from Mr. Wladyslaw St. Zbi[illegible] of Detroit for $2,7[illegible], and a German glider (Air Corps XTG-11) bought from Chester J. Decker of Glen Rock, N. J., for $2,000.[51] The Glider Branch accumulated comparative data on these gliders but found little or nothing of importance to recommend design changes in domestic gliders as a result of the tests.[52]

Summary

From 27 June 1941 to 18 August 1941, ten fixed-price contracts for 2- and 3-place experimental training gliders were awarded to nine companies, and two gliders of foreign design were procured from private owners. Including the three converted light airplane models which were purchased on production contracts, these gliders cost the Government a little more than $[illegible]. Of the sum, $1,531 was paid to three

50. "Glider Report," Vol. III, Pt. 1, pp. 17[illegible], 18[illegible], 1[illegible]; Vol. I, photographs, etc., XTG-5, XTG-6, XTG-9; Glider Pilot Training Program, p. 12, [illegible] plate opposite p. [illegible].
51. Table, "Gliders Acquired from Civilian Owners," 31 Jan. 1947, prepared by Analysis and Planning Br., Statistical Control Office, [illegible], copy in Control Sec., Proc. Div., AMSC.; Mat. Lab. Weekly [illegible], [illegible], 9 Oct. 1941; and AMSC, Model Designation of Army Aircraft, 11th ed., Jan. 19[illegible], p. 21.

German - Built XTG-11 (Mimmoa)



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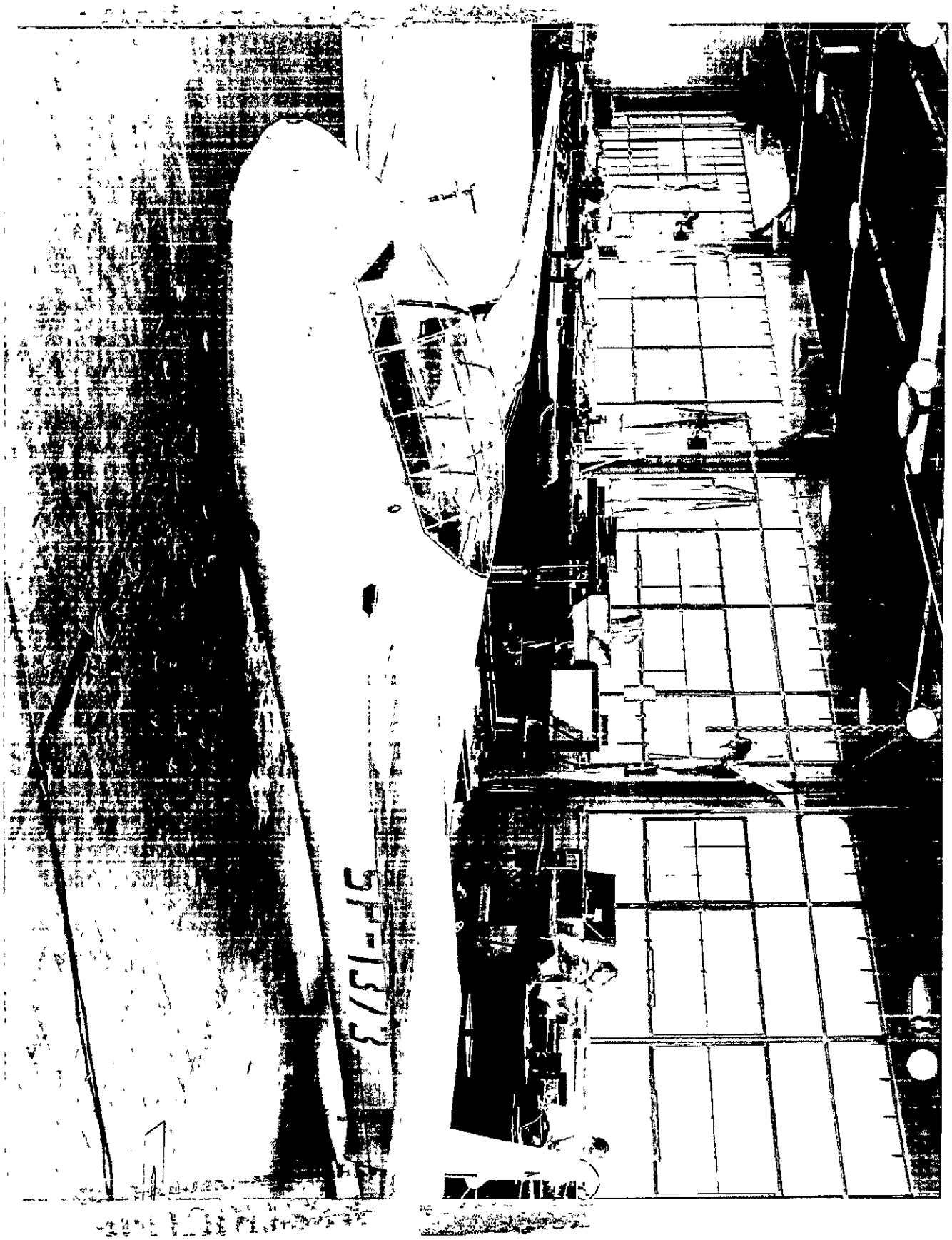
Polish Orlik



contractors whose gliders did not reach production.[53] The program as a whole provided the AAF with seven different production model training gliders. The high percentage of successful developments in the training glider program is best explained by the availability of commercial gliders and light aircraft. Preliminary designing and tooling work were not major problems, and the engineers of the Materiel Center were able to concentrate on modification of existing types. Most companies were able at the same time to furnish experimental models within a few weeks or months after signing a contract. These factors made the development of training gliders far less difficult than the procurement and development of tactical models.

Data pertaining to the experimental training glider program are summarized in the table on the following page.

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53. Finance Sec. File of Payments.

EXPERIMENTAL TRAINING GLIDERS

(Listed according to date of contract approval)

Model	Contractor	Contract No.	Final Status of Contract	Total Payments to Contractor	Placement in Production
XTG-1	Frankfort	19150	Completed	$5,784.99	Yes
XTG-2	Schweizer	20021	Completed	6,477.45	Yes
XTG-4	Laister-Kauffmann	21757	Completed	10,404.00	Yes
XTG-3	Schweizer	22074	Completed	13,209.00	Yes
XTG-12	Bowlus	28290	Cancelled	10,031.25	No
XTG-10	Wichita	30527	Cancelled	8,500.00	No
XTG-13	Briegleb	30563	Cancelled	3,000.00	No
XTG-5	Aeronca	30103	Completed	*	Yes
XTG-6	Taylorcraft	29841	Completed	*	Yes
XTG-8	Piper	31398	Completed	*	Yes
XTG-7	(Purchased from private owner)			2,700	No
XTG-11	(Purchased from private owner)			2,000	No
				$62,106.69	

* Payments made only on production contracts for these models.

The original of this monograph and the documents from which it was written are in the USAF Historical Division, Archives Branch, Bldg. 914, Maxwell Air Force Base, Alabama.

Chapter III

THE EXPERIMENTAL PROGRAM: TACTICAL GLIDERS

In contrast to the more easily handled training glider development project, the experimental program relating to tactical gliders taxed the ingenuity of Materiel Division and industrial engineers. In the absence of previous experience with cargo gliders, originality and designing skill became essentials of the tactical glider program. As has been pointed out earlier, speed was another essential, and before the completion of design studies preliminary engineering requirements for 15-place gliders were sent to 11 companies. Of these, only the Frankfort Sailplane Company, the Waco Aircraft Company, Bowlus Sailplanes, Inc., and the St. Louis Aircraft Corporation sent favorable replies. Most of the firms contacted replied that they had previous manufacturing commitments which they did not prefer to alter or that the proposed glider was too large for their facilities.[1] Thus early in its development work the Materiel Division ran into one of the major obstacles of the entire glider program, that is, the inexperience and limited capacity of the concerns willing and eligible to manufacture gliders. At the time the glider program was getting under way, nearly all of the established aircraft companies in the United States were expanding their production to meet requirements growing out of the European war. The Air Corps regarded the need for powered aircraft as paramount in view of the intensive

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1. MD Memo Rept. EXP-M-51/AD830, Add. No. 18, 9 June 1941.

defense program adopted in the United States, and the Materiel Division was instructed to place glider orders with companies not already engaged in the manufacture of metal or combat airplanes.[2] As will be seen later in this study, the Materiel Division was frequently reminded of this policy, and the restriction severely hampered the expeditious achievement of the glider development and production program.

Eight- and Fifteen-Place Models

Frankfort XCG-1 and XCG-2. Anxious to begin work at once with the facilities available, the Glider Branch initiated negotiations with the four companies which had shown an interest in the preliminary proposals. An Authority for Purchase was issued 7 May 1941 for experimental tactical gliders to be built by the Frankfort Sailplane Company. This preliminary authorization resulted in a fixed-price contract number ac-19381, approved 24 May 1941, providing for the construction of one each of static-test and flight-test models of 8- and 15-place gliders.[3] There were no deliveries on this contract until 27 December 1941, when a static test model of the 8-place XCG-1 was sent to Wright Field. This article failed at 63 per cent of the design load during structural tests, and was returned to the contractor.[4] At that time Frankfort was achieving a recognized success in the construction of the gliders on its XTG-1 contract, and gave evidence of being better suited for training glider production than for the development or manufacture of cargo types. The contract for the

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2. "Glider Report," Vol. I, p. 31; ICM, Actg. Chief, Fiscal Br., Proc. Div., to Chief, Proc. Div., WF, 29 March 1943, in ATSC Hist. Office; Glider Pilot Training Program, p. 2.
3. MD Memo Rept. EXP-M-51/AD830, Add. No. 18, 9 June 1941.
4. Airc. Lab. Weekly TT, 1, 29 Jan. 1942.

XCG-1 and XCG-2 was canceled by a termination agreement dated 31 March 1942.[5] The contractor received $30,478.85 for the delivery and other work accomplished on the contract.[6]

Waco XCG-3 and XCG-4. In March 1941 negotiations were begun with the Waco Aircraft Company of Troy, Ohio, for the construction of experimental gliders. Contract ac-19629, approved 17 June 1941, provided that Waco should build one static-test and one flight-test model of an 8-place (XCG-3) glider and one static-test and two flight-test models of a 15-place (XCG-4) glider.[7] Although Waco was not a large company, it had been a pioneer in the manufacture of commercial aircraft and was better prepared to handle a development contract than were most of the corporations to whom the Materiel Division turned in the early days of the glider program.[8]

The XCG-3 wind tunnel model was completed within a few weeks after the award of the contract, and tests of this model were completed in September. The article for structural test was delivered 26 December 1941, and the flight article was delivered 31 January 1942. Early in February the Aircraft Laboratory reported that flight tests of the XCG-3 indicated a promising model, and in April the XCG-3 was accepted as satisfactory for quantity production.[9] This glider was a high-wing monoplane with strut braces, a fuselage of welded steel tube construction, and wooden wings and empennage. It could be fitted with either of two

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5. "Glider Report," Vol. III, Pt. 1, p. 61.
6. Finance Sec. File of Payments.
7. "Glider Report," Vol. III, Pt. 1, p. 61.
8. "Glider Report," Vol. II, passim.
9. Airc. Lab. Weekly IT, 11 Sep. 1941, 1 Jan., 6 Feb., 17 April 1942.

Waco XCG-3

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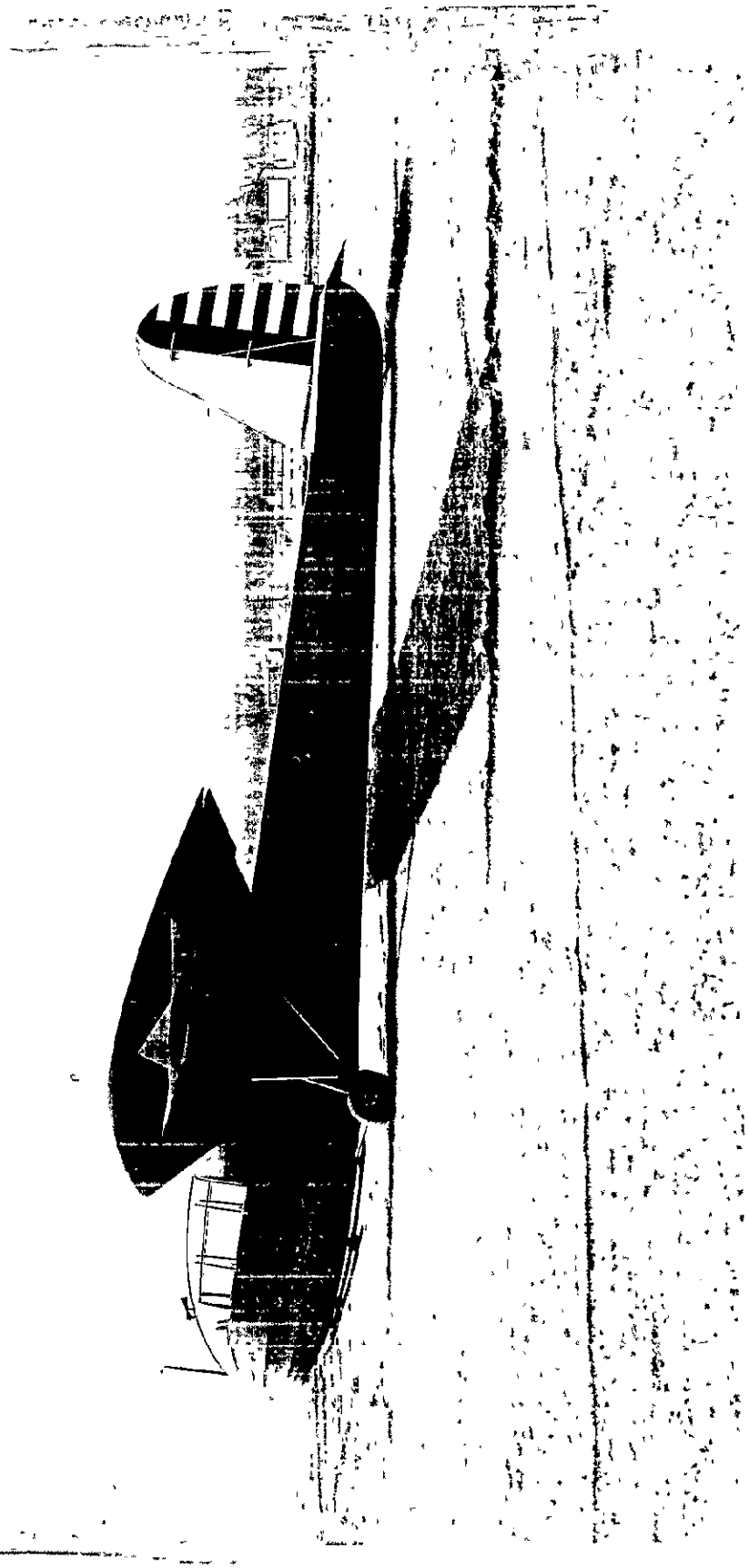

landing gears, a droppable one for operational use and a fixed-gear one for training. The design gross weight was 4,400 pounds, and design towing speed was 120 miles per hour. The glider carried eight men, including the pilot and co-pilot.[10] Production quantities of the CG-3A were ordered, but the total procurement was later substantially reduced in favor of the more suitable CG-4A.

The static test article of the larger XCG-4 was delivered 28 April 1942, and the first flight article arrived at Wright Field on 14 May.[11] Two days later the Materiel Center forwarded an official commendation to Waco. Prepared by Colonel Dent of the Aircraft Laboratory's Glider Branch, the letter acknowledged the many extra hours of work Waco employees had devoted to the project and stated that as a result the XCG-4 articles had been "delivered several months prior to dates that would have been possible under normal operating conditions of this Company."[12]

On 20 June the first flight article XCG-4 was declared satisfactory. The Materiel Command at Washington was informed at that time that it had been necessary to install a new rudder and fin combination, but that the glider as improved had proved acceptable. In a significant test, the XCG-4 had been successfully towed from Wright Field to Chanute Field and back, a distance of 220 air miles, carrying 15 passengers including the pilot and co-pilot.[13]

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10. "Glider Report," Vol. III, Pt. 1, p. 61.
11. Airc. Lab. Weekly TT, 30 April, 14 May 1942.
12. EES, Mat. Cent., to Waco, 16 May 1942, in ATSC 452.1, Waco Airc. Co.
13. TT EXP-T-1553, Tech. Exec., Mat. Cent., to CG, MC, Wash., 20 June 1942, in ATSC 452.1, Transport Gliders, 1942-43-44.

The XCG-4 was designed by Waco and Materiel Center engineers along the same general lines as the XCG-3, with differences arising primarily out of the larger size of the former. It was designed for a gross weight of 6,800 pounds and 150 miles per hour airspeed, and carried no armor or armament.[14] One of the most distinguishing features of the XCG-4 grew out of a suggestion by General Arnold, who had said:

> I would like very much to have a small light jeep constructed . . . jeep to carry two men and have light armor and guns. This jeep should be designed and constructed with a view of fitting wings to it so that we can take it off as a glider and drop it as a glider. Having dropped as a glider, it lands on a field somewhere, sheds its wings and goes around as a jeep.[15]

That proposal was translated into a directive to Wright Field calling for a study of the practicability of modifying a glider to carry a jeep "in a quickly dischargeable position." Early in November it was announced at AAF Headquarters that Waco was building two gliders capable of carrying a jeep and crew of six men.[16] The XCG-4 was constructed to allow the entire nose, including the crew compartment, to swing upward, thereby creating a 70 x 60-inch aperture into the interior of the glider. With those arrangements it was possible to unload a jeep merely by driving it out of the glider.[17]

Before Waco was able to deliver the static-test article on the XCG-4 contract, the Glider Branch had found that other experimental

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14. "Glider Report," Vol. III, Pt. 1, p. 62.
15. Quoted in CTI-318, 4 Sep. 1941, in A&S, Airc. Proj. Br., Glider File 4.110, General.
16. Ibid. R&R from C/AAF, 27 Nov. 1941, quoted in "Resume of AAF Glider Program to July 21, 1943," by Lt. Col. L. T. Bradbury, MD, Wash. [Cited hereafter as "Resume of AAF Glider Prog."]
17. "Glider Report," Vol. III, Pt. 1, p. 62.

contracts for tactical gliders showed little promise of supplying an acceptable 15-place glider. As a consequence, and in view of the urgent need for gliders and the early satisfaction with Waco's progress on the XCG-3 and XCG-4, production contracts for the Waco gliders were let before the completion of the experimental articles. In fact, before the first flight article XCG-4 was delivered, 11 companies had been awarded contracts for a total of 640 CG-4A's.[18]

For the development of the XCG-3 and XCG-4 gliders on the experimental contract Waco was paid $253,781.41, with the government committed to pay an additional $2,609.79 as of 31 October 1944.[19] On 23 July 1942, Waco claimed a loss on the XCG-4. It was "well known to the Contracting Officer," a company official said, "that the base price of the XCG-4 contract as paid by the Government resulted in a considerable loss to the manufacturer."[20]

St. Louis XCG-5 and XCG-6. The St. Louis Aircraft Corporation, one of the four companies interested in the Materiel Division's first proposal for glider construction, was given a contract for 8- and 15-place models. Contract ac-19630 was approved 28 June 1941. Subsequently the 15-place XCG-6 was canceled, leaving a contract for a static-test and a flight-test 8-place XCG-5.[21] The XCG-5 was expected to serve as a model for

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18. See Chap. V.
19. Finance Sec. File of Payments. It should be pointed out that the unpaid obligation, that is, the sum due Waco, was subject to negotiation at the time of this study, and as of May 1945, may be changed before payments are completed.
20. H.H. Perry, Vice Pres., Waco, to Airc. Lab., 23 July 1942, in ATSC 452.1, Transport Gliders, 1942-43-44.
21. Contr. W535 ac-19630.

St. Louis XUQ-5

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investigation of the effect of light wing-loading on flying characteristics.[22] Tests of the wind-tunnel model were completed in September 1941,[23] and early in 1942 the static-test article was delivered to Wright Field. Structural tests of the XCG-5 produced a serious failure at the 90 per cent load.[24] The flight test article delivered in October 1942[25] was no more successful, displaying an unsatisfactory balance condition which would have necessitated a complete redesign of the glider for further consideration. As a result, there was no additional development of the XCG-5.[26] St. Louis Aircraft was paid $53,028.80 for its work on the XCG-5 and XCG-6.[27]

Bowlus XCG-7 and XCG-8. The fourth company which sent a favorable reply to the Materiel Division glider proposal was Bowlus Sailplanes, Inc. Contract ac-20234, approved 2 October 1941, called for the manufacture of four Bowlus gliders of 8- and 15-place design. One each of static-test and one each of flight-test 8- and 15-place gliders were to be delivered by March 1942.[28] These gliders were of wood and fabric construction, were unarmed, and had a design towing speed of 120 miles per hour, with design gross weights of 5,000 and 7,450 pounds, respectively.

The 8-place XCG-7 static-test glider was delivered to Wright Field on 10 February 1942, and promptly failed under a structural test.

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22. "Glider Report," Vol. III, Pt. 1, p. 62.
23. Airc. Lab. Weekly TT, 11 Sep. 1941.
24. "Glider Report," Vol. III, Pt. 1, p. 62.
25. WS-378, "Aircraft Acceptances, Factory Deliveries, and Departures from U.S. by Type, Model and Recipient Country; Based on Contracts Active as of January 1, 1941 (Excluding Direct Navy, Navy Lend Lease, and Commercial)," for period January 1941-December 1943, inclusive, p. 176, prepared by Airc. Delivery Unit, SCO, MC. [Cited hereafter as "WS-378, Airc. Acceptances."]
26. "Glider Report," Vol. III, Pt. 1, p. 62.
27. Finance Sec. File of Payments.
28. Contr. W535 ac-20234; "Glider Report," Vol. III, Pt. 1, p. 114.

Bowlus did not complete repairs until near the first of July. During further structural tests the glider failed at tow loads of 40 to 60 per cent.[29]

In the meantime AES at Wright Field reported that as a result of "the close financial relationship between Mr. Bowlus . . . and official personnel of Douglas Aircraft Company, the latter concern took over the design of the fifteen-place glider in behalf of Mr. Bowlus." There was "quite a close tie-up between this outfit [Bowlus] and the Douglas Company."[30]

As work on the gliders progressed, the Bowlus organization appears to have displayed more talent for salesmanship than for the manufacture of gliders. The point is significant in view of the manner in which Bowlus officials, affiliated personnel, and Bowlus schemes persisted in the glider program in spite of a series of failures and setbacks. One of the major problems of Wright Field officials in the glider program was that of judging the soundness, capacity, and skill of the small companies anxious to secure government contracts and prone to overestimate their own ability. Because it so fully illustrates the nature of this factor in the glider program, the Bowlus case is presented here in some detail.

On 5 April 1942 Norman Larson, vice president of Bowlus, submitted to the Materiel Center a proposed production scheme. Larson announced

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29. Airc. Lab. Weekly TT, 13, 26 Feb., 2, 24 July 1942.
30. MD Memo Rept. EXP-M-51/AD830, Add. No. 18, 9 June 1941; TT EXP-T-232, Exp. Eng. Sec., WF, to Exp. Eng. Br., MD, Wash., 12 June 1941.

Bowlus' "preparedness and readiness to enter an immediate program of glider production." A number of woodworking facilities would soon become idle, he pointed out, and steps had already been taken to enlist these companies in a vast production program for wooden gliders of Bowlus design. A number of executives of such firms had inspected the Bowlus glider project at Los Angeles and were estimating production costs. Only those companies capable of producing at least one glider per day had been selected. This was explained as follows:

> We have picked organizations with these minimums, since it is our plan to place our own trained personnel right at each plant, and hence must concentrate as much as possible. Naturally we would prefer to start out with one factory at a time, but with everyone working under pressure, we estimate that we could handle three at the start - and we have three adequate plants ready and waiting to go. In addition, we have others in the offing for future use when needed.

Under the plan outlined, Bowlus would serve as prime contractor, supplying production and tooling designs and drawings, supervisors, instructors for training factory personnel of the subcontractors, and trained men for final assembly and inspection. Bowlus would also become the "one reliable source" responsible to the Materiel Center in this "coordinated effort." As the woodworking facilities were in the Middle West, Larson added that Bowlus personnel would be moved from Los Angeles "to a location central to these plants, possibly with our main unit adjoining one factory and branches at the others." There was one problem of note: the firms scheduled to become subcontractors were suffering a rapid curtailment of their current production and must soon be engaged in the glider program if they were not to lose trained personnel. The

entire Bowlus scheme Larson characterized as a "'ready-to-go' production proposition."[31]

On 30 April Bowlus informed Col. Fred R. Dent, Chief of the Aircraft Laboratory's Glider Branch, that plans were being formulated for the production of 100 XCG-8 gliders. By July the Bowlus letters had become familiar, personal notes. Colonel Dent was addressed "Dear Fred," and Maj. B. B. Price of the Aircraft Laboratory was addressed "Dear Bruce." "Best personal regards to Stoltzy" were meant for Lt. A. J. Stolzenberger of the Glider Branch; and Norman Larson, now General Manager of Bowlus, signed the letters "Norm." On 17 July 1942, Larson informed Major Price that "Lew and Dr. Klemperer" (Maj. Lewin B. Barringer and Dr. Wolfgang Klemperer, consulting engineer for the Douglas Company) had flown the XCG-7 and "both of them were tremendously enthusiastic about it."[32]

Apparently this enthusiasm for the glider and the attempts to place the negotiations on a personal friendship basis were not shared by engineers of the Materiel Center. By December 1942 neither the XCG-7 nor the XCG-8, nor the XTG-12 as noted earlier, was making appreciable progress toward acceptance as a production glider, and the Bowlus organization notified Wright Field that the corporation was "in dismal financial condition." The following month Bowlus officials, unable to raise capital and nearly bankrupt, threw themselves "upon the mercy of

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31. Norman Larson, Vice Pres., Bowlus Sailplanes, to EES, 5 April 1942, in ATSC 452.1, Bowlus Sailplanes.
32. Larson to Col. Dent, 30 April, 25 July 1942; Larson to Maj. Price, 17 July 1942; in ATSC 452.1, Bowlus Sailplanes.

Materiel Center."[33] By September 1943 the XTG-12 contract had been canceled, the XCG-7 had proved of "limited military utility," and the XCG-8 had failed during structural tests. The static-test and flight-test models of the XCG-8 were accepted by the Materiel Command on a negotiated basis,[34] and there was no production procurement of any of the Bowlus gliders. The contractor was paid $233,939 for the XCG-7 and XCG-8 articles, trailers, and related data.[35] The flight article XCG-8 was destroyed in a storm at Wilmington, Ohio, in June 1943, and in August of that year the flight-test model XCG-7 was sent to the High Voltage Laboratory of the National Bureau of Standards for use in tests of the means of protecting wooden aircraft from lightning.[36]

Timm XCG-4B. In a further experiment with wood construction in gliders, the Materiel Center awarded the Timm Aircraft Company of Los Angeles a contract for the construction of a plywood fuselage for the CG-4A glider. The purpose of this project was to insure a satisfactory all-wood design for the CG-4 fuselage in the event that steel tubing (used in the CG-4A) became so critical that it could not be made available to glider contractors. The contract (ac-28384) was approved 13 May 1942[37] and in April 1943 Timm delivered an XCG-4B with a wooden fuselage.[38] For its work on this contract Timm received $38,975.[39] The model was not placed in production.

Waco XCG-15 and XCG-15A. By the fall of 1943 an accumulation of

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33. Bowlus to Mat. Cent., 15 Dec. 1942, 13 Jan. 1943.
34. Contr. W535 ac-20234; "Glider Report," Vol. III, Pt. 1, p. 63.
35. Finance Sec. File of Payments.
36. "Glider Report," Vol. III, Pt. 1, p. 73.
37. Contr. W535 ac-28384; interview, Maj. W. C. Lazarus, 7 Dec. 1944.
38. "HS-378, Airc. Acceptances," p. 175.
39. Finance Sec. File of Payments.

evidence indicating the need for modifications of the CG-4A led to the decision to incorporate needed changes in a new model glider. The production of the CG-4A would by this expedient be continued with the least interference. On 14 October 1943 a Change Order to Waco's production contract ac-25851 provided for the construction of an XCG-15 resembling the CG-4A but with a clipped wing as its most distinguishing feature.[40] On 10 January 1944 the XCG-15 was delivered to Wright Field. Following the installation of an improved nose section, flight tests were begun in February.[41] In May an Authority for Purchase was issued calling for two flight-test articles and a static-test article XCG-15A. This glider was a further modified XCG-15.[42] On 21 September contract W33-038 ac-3163 was approved for the construction of the XCG-15A gliders at an estimated cost of $270,456.05. This was a cost-plus-a-fixed-fee contract.[43]

The XCG-15A was designed as an improvement of the CG-4A production glider. Prominent features of the glider were new ailerons for improved control, crash protection for passengers and crew, higher towing speed, greater useful load, an improved landing gear, improved visibility for the pilot, and a higher rate of sink made possible by the use of flaps, which also reduced the amount of power required to tow the glider at speeds in excess of 120 miles per hour. Flight tests of this model

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40. "Glider Report," Vol. III, Pt. 1, p. 113.
41. Airc. Lab. Weekly TT, 14 Jan., 4 Feb. 1944.
42. Airc. Lab. Weekly TT, 5 May 1944.
43. Contr. W33-038 ac-3163.

were under way in November 1944.[44]

Chase XCG-14. The final experimental contract for a glider of the 15-place class was given to Chase Aircraft Company of New York on 30 October 1943. Contract ac-1206 provided for the manufacture of two flight-test articles and one static-test model of the Chase MS-1, AAF Model XCG-14 glider.[45] The static-test glider was delivered on 17 August 1944, and although not built exactly to the desired specifications, this article had proved 100 per cent structurally sound on all tests run to 1 November 1944.[46] At that time the contractor had been paid approximately $190,000.[47] In view of the early success of the static-test glider, and in an attempt to realize more fully on the government's investment to date in the Chase project, the AAF Area Representative in the New York area was asked to do everything possible to expedite the delivery of a flight-test article.[48]

Thirty- and Forty-two-Place Models

In December 1941 Colonel Dent returned from an inspection tour of glider activities in England, bringing with him impressions of British

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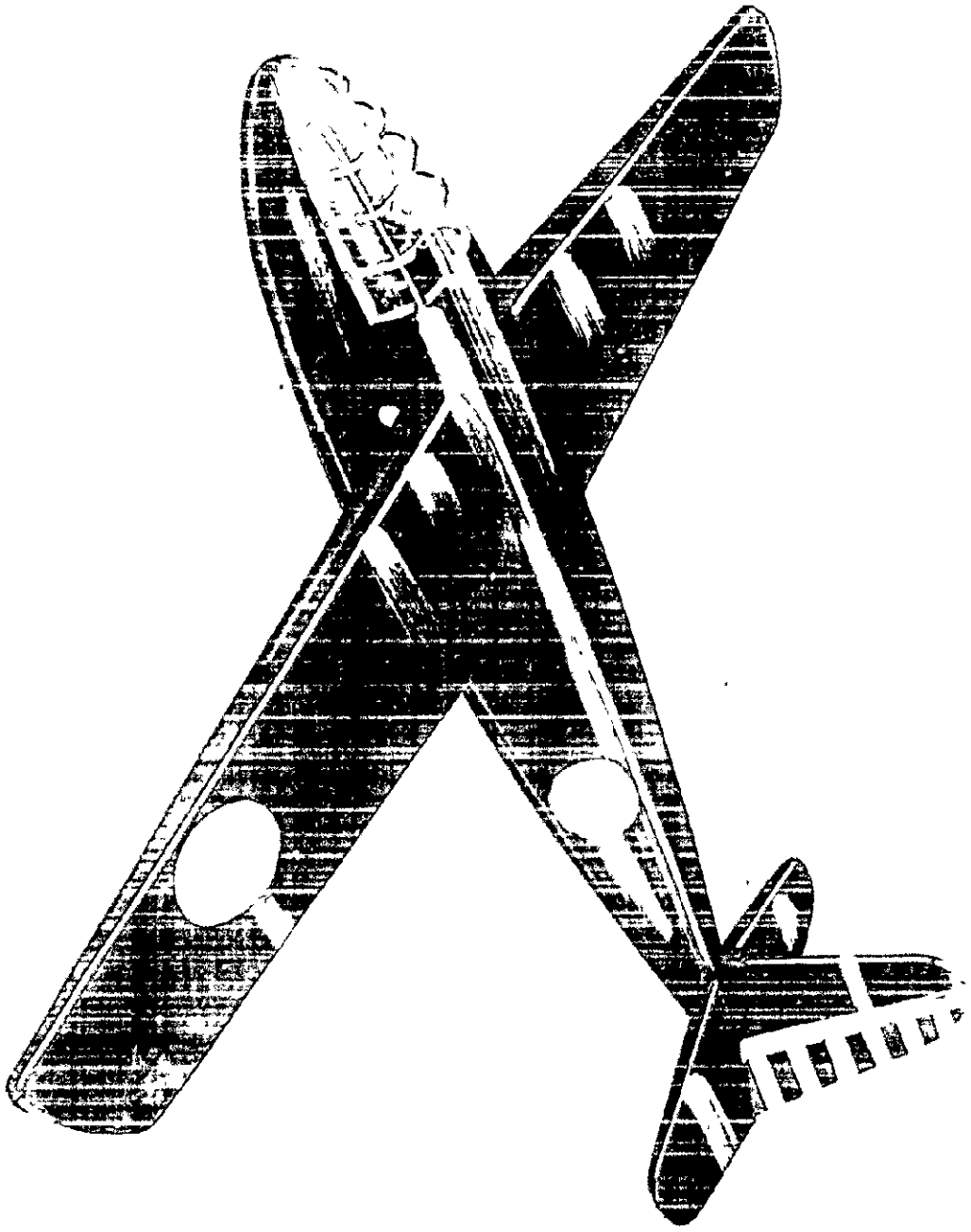
44. 1st ind. (basic unknown), MC to AC/AS, M&S, 2 Sep. 1944, in Corres., XCG-14, in Airc. Lab.; Airc. Lab. Weekly TT, 30 Nov. 1944. Because of its possible importance in the future procurement program, the following estimate in February 1945 by Maj. W. C. Lazarus of the Engineering Division's Glider Branch is pertinent: "The XCG-15A proved to be a very superior article and was placed in production as the CG-15A with deliveries of production article made in December 1944. The entire project from initial conception to delivery of production quantities recuired only fourteen months." Interview with Major Lazarus by author, 7 February 1945.
45. Contr. W33-038 ac-1206.
46. Airc. Lab. Weekly TT, 18, 24 Aug., 2 Nov. 1944.
47. Finance Sec. File of Payments.
48. Telg., TSEIA-2B-10-85, ATSC to AAF Area Representative, N.Y. Area, 12 Oct. 1944, in ATSC 452.1, XCG-14.

Chase XGF-14



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plans for the development of a 30-place glider capable of carrying 30 men or heavy field pieces.[49] This stimulus of new ideas linked with the obvious desirability of increasing the useful load of AAF gliders, resulted in a program for the development of 30- and 40-place troop-cargo gliders.

Snead XCG-11. The first contract for a 30-place glider was that given to Snead and Company, Jersey City, N. J., for the XCG-11. This contract, number ac-27358, approved 21 April 1942, was for three gliders. The XCG-11 fuselage was to be built of a noncritical steel tubing to determine the advisability of using this material in heavy gliders. The Materiel Center's design conceptions for the XCG-11 called for a craft capable of a towing speed of 150 miles per hour and having a gross weight of 15,000 to 16,000 pounds. The wing span was to be 112 feet, fuselage length 35 feet.[50]

On 24 July 1942 the contractor supplied a wind tunnel model which was not satisfactory. On 29 August Snead asked for an extension of the delivery dates, and the request was granted. In September the contractor requested renegotiation of the contract to provide a cost-plus-a-fixed-fee contract with an increase in the contract price from the original $265,000 to $577,000. There were no deliveries on the contract, and on 9 June 1943 it was canceled.[51] Payments to Snead on this contract totalled $143,118.25.[52]

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49. "Glider Report," Vol. I, p. 30.
50. Ibid., Vol. I, pp. 55-56; Vol. III, Pt. 1, p. 120. The Snead Company was incorporated in New Jersey in 1900 and had manufactured library book stacks, steel and glass office partitions, and other office equipment before World War II. The war role of the company had been principally that of subcontractor to Republic Aviation for welded aluminum assemblies. Ibid., Vol. II, sec. on Snead.
51. Airc. Lab. Weekly TT, 30 July 1942; "Glider Report," Vol. III, Pt. 1, pp. 78-79, 120.
52. Finance Sec. File of Payments.

Laister-Kauffmann XCG-10 and XCG-10A. In April 1942 the Laister-Kauffmann Aircraft Corporation was given a contract for three XCG-10's, 30-place troop-cargo gliders of wood construction.[53] This glider was designed for a useful load of 8,000 pounds at a gross weight of 15,980 pounds, and a towing speed of 150 miles per hour, and was to be 68 1/2 feet long with a 105-foot wing span.

The contractor was unusually slow in accomplishing completed articles, and claimed that manufacture of the XCG-10 had been held up by an AA-3 priority on the project which made it exceedingly difficult to secure material and parts.[54] The first flight-test and static-test articles were not delivered until October 1943. In the meantime the Waco Aircraft Company had completed its XCG-13 30-place glider. When the XCG-13 was approved for production in the fall of 1943, the XCG-10 was dropped, and the Laister-Kauffmann contract was changed to call for an XCG-10A, a 42-place glider of wood construction.[55]

A flight-article XCG-10A was delivered to the Clinton County Army Air Field on 30 April 1944, and in August the Glider Branch declared the glider suitable for production.[56]

The outstanding feature of the XCG-10A was a cargo compartment 6 2/3 feet high by 8 1/2 feet wide. The glider could carry a 2 1/2 ton, 6 x 6 truck, or 42 troops, or two 105-mm. howitzers, or one 155-mm.

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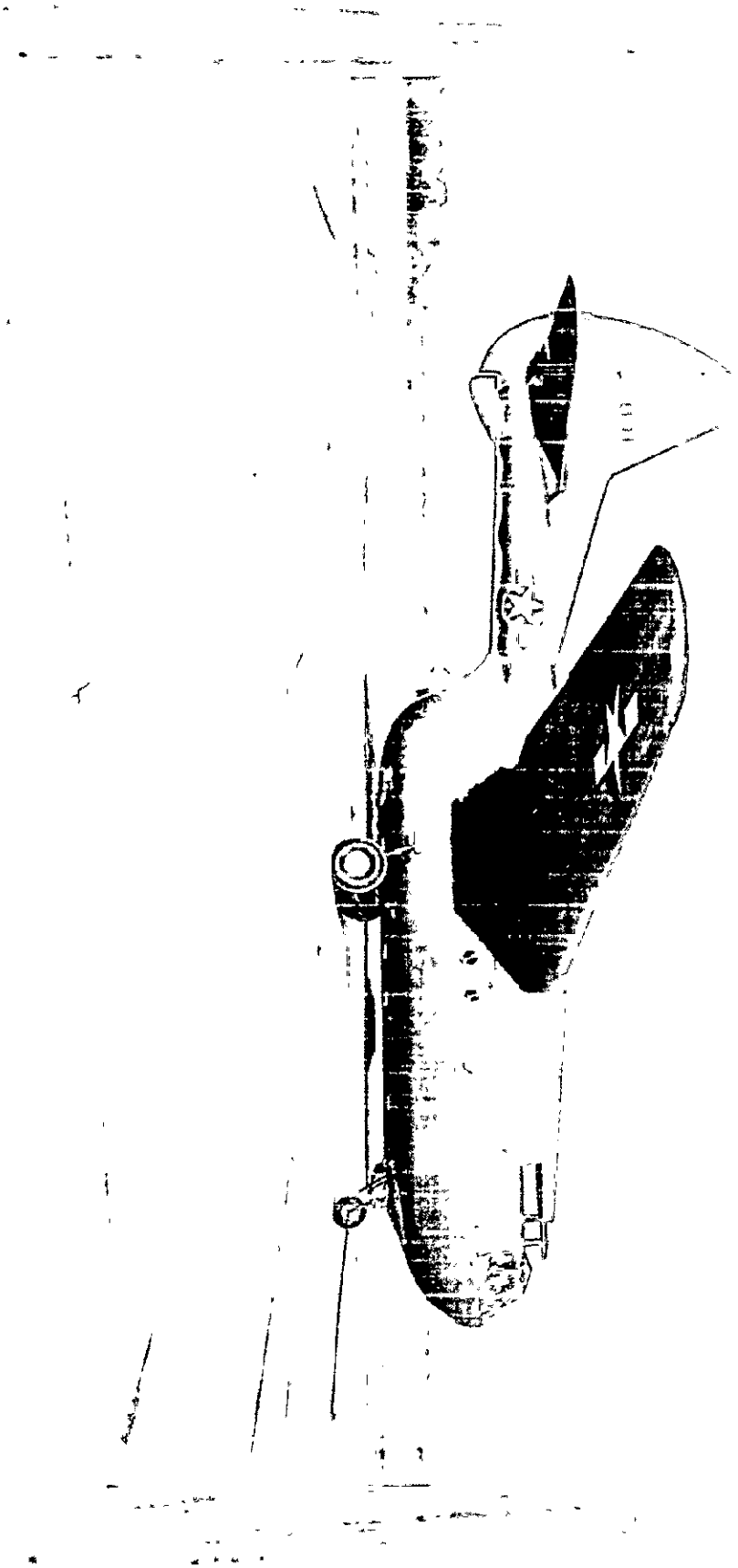
53. Contr. AC-27357.
54. Airc. Lab. Weekly TT, 20 Nov. 1942.
55. Ibid., 8, 29 Oct. 1943; ICM, Chief, Airc. Lab. to Chief, Eng. Div., 6 Sep. 1944, in ATSC 452.1, Laister-Kauffmann; Memo for File, 6 Jan. 1944, in M&S, Airc. Proj. Br. Glider File, 4.11001, Reports.
56. Airc. Lab. Weekly TT, 5 May, 31 Aug. 1944.

Leister-Kaufmann XGG-10



howitzer. In September 1944 it was the only large wooden aircraft in recent years which had successfully passed static testing.

On 6 September the Aircraft Laboratory pointed out that although Laister-Kauffmann was slow in making deliveries, "the workmanship performed by this company is the equal or superior of any other glider manufacturer." The Laboratory recommended the procurement of a service test quantity of XCG-10A's.[57]

As of 1 November 1944 the future of the XCG-10A was not assured, but its possibilities as a production glider were enhanced by a somewhat extensive interest in large gliders. As early as October 1943, the Airborne Command expressed a desire for "large, high performance transport gliders,"[58] and a year later the I Troop Carrier Command asked the Air Technical Service Command to have evaluation tests of the XCG-10A completed as soon as possible.[59] On 31 October 1944 the ATSC Engineering Division requested the AAF Board at Orlando, Fla., to set up a test program for the Laister-Kauffmann glider.[60] As of the date of that request the government had paid Laister-Kauffmann a little over $774,000 for the XCG-10A project, including its antecedent, the XCG-10.[61]

G & A XCG-9. One of the most striking failures of the experimental glider program occurred in the case of G & A Aircraft's XCG-9. A contract (ac-25554) for three 32-place troop-carrier gliders was awarded the AGA

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57. IOM, Chief, Airc. Lab., to Chief, Eng. Div., 6 Sep. 1944.
58. R&R, AC/AS, OC&R to AC/AS, MM&D, 4 Oct. 1943, copy in "AAF Glider Prog., Prod. Proc.," App. P.
59. Chief, Eng. Div. to AAF Board, 31 Oct. 1944, in ATSC 452.1, XCG-10A.
60. Ibid.
61. Finance Sec. File of Payments.

Aviation Corporation of Willow Grove, Pa., on 3 July 1942. The original contract price was $299,820.55. The contractor, reorganized as G & A Aircraft, Inc., was unable to meet delivery schedules and by November 1942 was accumulating costs out of proportion to contingent accomplishment. The Aircraft Laboratory took the view that any possible deliveries on the contract would occur too late for proper evaluation of the glider before it became necessary to effect quantity procurement of such aircraft. On 2 December 1942 the contract was canceled.[62]

The termination supplement was not completed until 8 November 1943. Total payments to the contractor were $212,128.25, or more than two-thirds of the original contract price. For this sum, in addition to the design data and experience accumulated before the cancellation, the government received a large stock of aircraft materials and supplies on hand at the contractor's plant at the time of termination.[63]

Waco XCG-13. By the fall of 1942 the CG-4A was in production and Waco, designer of the glider, was in a position to undertake a new development project. The Glider Branch desired to apply Waco's experience with 15-place gliders to the problem of developing gliders of larger capacity. Contract ac-31734, approved 23 September 1942, assigned to that company the development of a 30-place troop-carrier glider having a design towing speed of 174 miles per hour at 12,000 feet, a gross weight of 15,000 pounds, and a useful load of 8,000 pounds. Other design features of the XCG-13 were an 86-foot wing span, over-all length of 54

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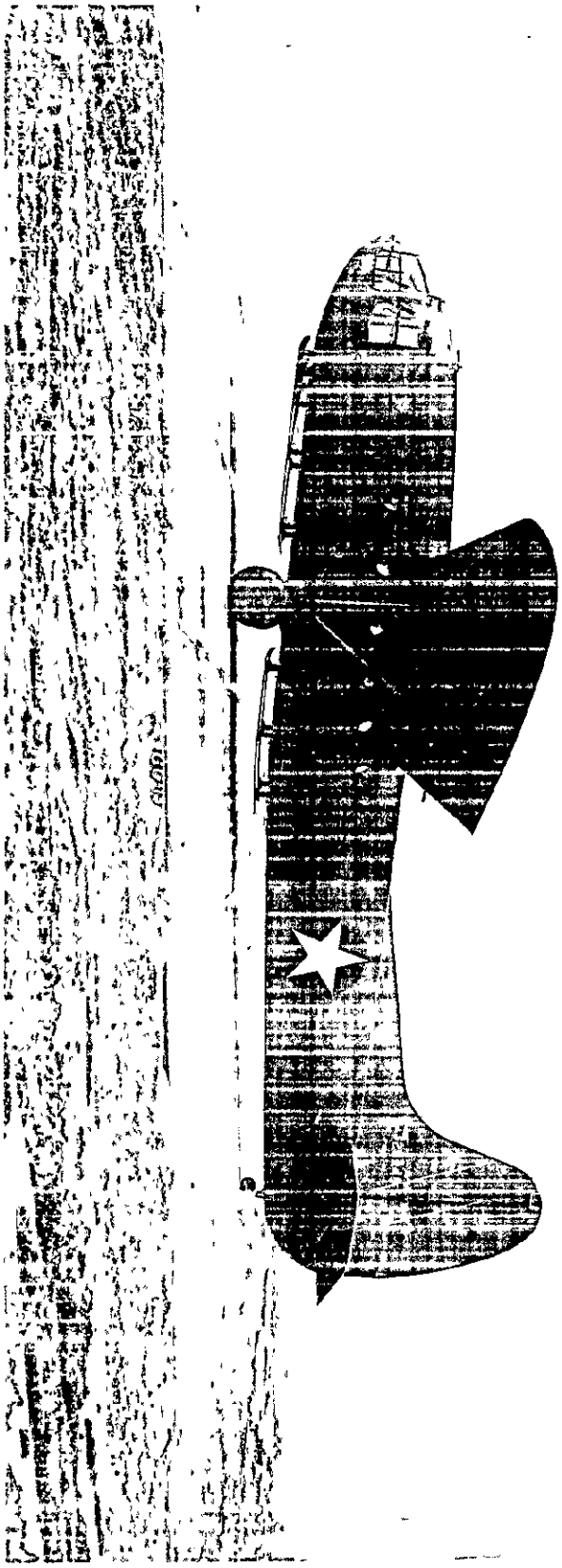
62. "Glider Report," Vol. I, p. 52; Vol. III, Pt. 1, pp. 116,250-51; Airc. Lab. Weekly TT, 11 Dec. 1942.
63. Contr. W535 ac-25554; Finance Sec. File of Payments.

Waco XCG-13



feet, a welded-tube-construction fuselage, and externally braced wooden wings.[64]

The first flight article delivered on this contract arrived at Wright Field on 10 March 1943, and was immediately subjected to tests. On 18 March the Aircraft Laboratory reported that the glider had successfully passed flight tests to date. The second flight article was delivered to the Clinton County Army Air Field on 6 July, but it was destroyed by a tornado a few days later and all modifications incorporated in the glider were transferred to the first XCG-13. Deliveries were completed on 7 July, when the static-test model was assigned to the Materiel Command for structural testing.[65]

The XCG-13 was the first of the large gliders to meet AAF requirements, and service test and production quantities were ordered. For the development and construction of the experimental gliders, the contractor was paid $371,673.12 to 31 October 1944, at which time the government owed Waco an additional $1,547.84 on the contract.[66]

Read-York XCG-12. At the time contractual arrangements for the XCG-13 were being completed, negotiations were under way with the York Aircraft Corporation of New York for the construction of a 30-place troop-carrier glider. On 24 September 1942 this company was given a contract (ac-31730) for the XCG-12, a 17,631-pound (gross weight) glider with a useful load of 8,283 pounds, a 112-foot full cantilever wing, and an over-all length of 70 feet.[67] The York Corporation was soon

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64. Contr. W535 ac-31734; "Glider Report," Vol. I, p. 60.
65. Airc. Lab. Weekly TT, 18 March, 9, 22 July 1943.
66. Finance Sec. File of Payments.
67. "Glider Report," Vol. I, p. 58; Vol. III, Pt. 1, p. 123.

involved in financial difficulties, and in May 1943 the contract was canceled. A new contract for the XCG-12 was given to Read-York, Inc., a New York firm created for the purpose of acquiring the York contract.[68]

The Read-York XCG-12 project is an excellent illustration of the financial insecurity common to many of the glider contractors and of the government's willingness to award contracts under such conditions. Read-York began work on the XCG-12 with $100 capital, and it was understood that the government would finance the contract. In this instance, however, as in nearly all cases in the experimental glider program, the Materiel Command carried "insurance" against excessive costs, by means of the fixed-price contract.[69]

The contractor was able to meet the first estimated delivery date by furnishing a static-test article on 27 July 1943,[70] but the wings of the glider failed in structural tests at 78 per cent of the positive high angle of attack load. On 5 November the Glider Branch reported that "it has been decided to cancel the Read-York XCG-12 glider due to the fact that it would require too much redesign to make this glider structurally sound."[71]

The Notice of Default sent to the contractor in December indicates, however, that structural failure was not the sole factor prompting cancellation. Delivery of the flight-test gliders required in August and September was not accomplished, in spite of the fact that by 1 September the government had paid Read-York the full contract price

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68. "Glider Report," Vol. III, Pt. 1, p. 65; Vol. II, Pt. 2, sec. on Read-York.
69. ICM, Maj. Lloyd W. Dinkelspiel, Legal Br., to Chief, Legal Br., MC, 25 Nov. 1943, in Corres., Read-York, in Airc. Lab.
70. Ibid.; "Glider Report," Vol. III, Pt. 1, p. 118.
71. Airc. Lab. Weekly TT, 29 Oct., 5 Nov. 1943.

of $426,230. Manufacturing costs on the XCG-12 mounted rapidly, and in October the contractor stopped work on the contract for lack of funds.[72] The Materiel Command formally directed Read-York to stop work on 6 December 1943.[73] At that date the contractor had been paid partial payments totaling $333,359.40 and advance payments totaling $213,115, of which $146,435.30 was unliquidated. With this amount of unrecouped advance payments, payments retained by the contractor totaled $379,794.70.[74]

Less than a month after the Materiel Command directed termination of work on the XCG-12, Read-York carried the case to the War Department Board of Contract Appeals. The company appealed on "each and every one of the findings of the Contracting Officer" as shown in the termination notices, and asked that the condition of termination be changed from default to convenience of the government. The appeal was denied on 30 May 1944, and a month later Read-York was declared bankrupt in the United States District Court for the Eastern District of Wisconsin. In August 1944 the Materiel Command notified the Judge Advocate General in Washington that Read-York owed the AAF $49,553.43 principal and interest on advance payments not recouped. As a result of this claim, the government became involved in the Read-York bankruptcy proceedings.[75] As of 31 October 1944 total payments to Read-York on the XCG-12 contract remained at $379,794.70.[76]

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72. Notice of Default, MC to Read-York, 6 Dec. 1943, in Corres., Read-York, in Airc. Lab.
73. Termination of Work Notice, MC to Read-York, 6 Dec. 1943, ibid.
74. Notice of Default, MC to Read-York, 6 Dec. 1943, ibid.
75. Letter of Appeal, Read-York to S/W, 30 Dec. 1943, ibid.; Telg., P.D.-4181D, MC to JAG, WD, 22 Aug. 1944.
76. Finance Sec. File of Payments.

General Airborne Transport XCG-16. In February 1942 William Hawley Bowlus of Bowlus Sailplanes began the design and construction of a flying-wing type glider. A half-size prototype of the glider was completed later that year, and in October 1942 Bowlus and an associate, Albert Criz, began a campaign to obtain a government contract. Organized as Airborne Transport, Inc., of Los Angeles, these men, with later additions to the organization, became active promoters of the Bowlus-designed MC-1 glider. The company was later reorganized as the Albert Criz Company which became, in turn, the General Airborne Transport Company. In October 1943, key personnel in the organization were Hawley Bowlus, Albert Criz, Isidore Lidenbaum (an attorney), Glenn H. Bowlus, and Fred D. Bowlus. The General American Transportation Corporation of Chicago owned a controlling interest in the General Airborne Transport Company.[77]

In December 1942 Airborne Transport submitted a production proposal to the AAF which was supported by an energetic propaganda campaign conducted by Albert Criz. On 12 December Criz notified Maj. A. E. Blomquist of the Directorate of Air Support that the Navy was looking with favor upon the plans for the flying-wing type glider and suggested that the company could make better progress if it had an order. With characteristic audacity Criz said, "We must push immediately in order to get ships to the battlefront in time for a Spring offensive."[78] In January 1943 Colonel Dent reported that the Criz proposal was neither

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77. "Glider Report," Vol. VI, sec. on Bowlus-Criz XCG-16.
78. Albert Criz to Maj. A. E. Blomquist, 12 Dec. 1942, in M&S, Airc. Proj. Br. Glider File, 4.211, Experimental, CG-16.

accurate nor reasonable: "Drag estimates were ridiculously low" and performance characteristics were "highly optimistic." The company revised its data to provide more reasonable performance estimates, but in so doing radically altered the contours of the glider. In addition, Colonel Dent observed that Airborne Transport had "inadequate financial backing, no engineering personnel, and no definite organization or experience." To negotiate a contract with such a company "would be inviting trouble similar to that experienced with G & A Aircraft and Snead Company." In view of this opinion of the company, it was suggested to Criz that he attempt to interest a larger aircraft manufacturer in the project. Colonel Dent reported that "This suggestion was received very coldly. I think they visualize the big sign over the factory." These considerations led the Glider Branch to recommend that no further consideration be given the project unless a proposal relating to the MC-1 glider could be secured from "a reputable company obviously competent to handle the development."[79]

While the Materiel Center was voicing its opposition to the Airborne Transport proposal, a number of officials in Washington actively favored the Bowlus-Criz glider. At a Washington conference of 5 February 1943 relating to the general glider program, Maj. Felix duPont of the Air Transport Command said: "We would certainly like to test a wing designed cargo trailer similar to one which is engineered by Airborne Transport, Inc., which we understand can be towed 140 m.p.h. and has a 10,000 lbs. pay load capacity." Col. R. G. Landis, Chief of Staff, I Troop Carrier

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79. Ibid.; see also Maj. Gen. Charles E. Branshaw to Prod. Br., M&D, 26 Feb. 1944, in M&S, Airc. Proj. Br. Glider File, 4.1119, Airborne Transport.

Command, also expressed a desire to test one of these gliders. He said this glider was reported to have "a much better wing loading factor than the CG-4A."[80]

On 16 February Maj. Gen. O. P. Echols, Commanding General of the Materiel Command, notified the Director of Military Requirements that "in view of the enthusiasm of the Air Surgeon, the Aviation Engineers, the Air Transport Command and the Troop Carrier Command . . . in the particular glider design proposed by Airborne Transport, Inc., I have recently directed a special investigation of this entire matter." General Echols pointed out that engineers of the Glider Branch had taken an unfavorable view of the proposal. However, since there was an implication of doubt concerning the validity of the Glider Branch reports on the proposal, further consideration of the glider and of Airborne Transport was directed. Brig. Gen. A. W. Vanaman, Commanding General of the Materiel Center, Brig. Gen. C. E. Branshaw of the Western Procurement District, Brig. Gen. B. W. Chidlaw, Assistant Chief of Staff for Engineering Materiel Command, and "qualified engineers, entirely independent of the Materiel Center" all inspected the Airborne Transport facility and conferred with Criz and Hawley Bowlus.

The report made by General Echols after the investigation declares:[81]

> The "factory" turned out to be a small store building formerly used as a dry cleaning shop. The building was a one-story affair approximately 30 feet wide and 100 feet long, just large enough for the small model glider they have built to fit in sideways. The visible equipment consisted of a couple of drafting tables, a few drawing instruments and a couple of carpenter benches. Both

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80. "Minutes of Conference Held in A-3 Div., Air Staff, Feb. 5, 1943, to determine the AAF Glider Prog.," Exhibit F in "Resume of AAF Glider Prog."
81. R&R, No. 5, MC, Wash., to AF EMR, 16 Feb. 1943, in ATSC Hist. Office.

Mr. Criz and Mr. Bowlus hastened to explain that they had much better facilities in mind in case they landed a contract but were, at present, working on, more or less, a "shoestring".

In addition, it was discovered that the list of men Airborne Transport had "tentatively lined up" to prepare design details were nearly all employed by aircraft manufacturers and their loss would seriously interfere with production already under way elsewhere. As for the glider itself, it was a twin boom, flying-wing type which had not proved successful in earlier trials. A similar glider (the Cunliffe-Owen) built in England had not been "particularly successful," and only one of that type was built. The investigating officers had examined the cockpit mock-up of the Bowlus glider at the Airborne Transport plant and believed that loading problems would be severe and the design of the glider would necessarily be complicated and cumbersome. British experience had indicated that the transport of so many troops in a small space similar to that utilized in the MC-1 posed "problems of air-sickness and ineffectiveness of the troops upon landing."

General Echols insisted that the labor, engineering, financial, and program problems relating to a development project were matters which the Materiel Command, "and only this command," was empowered to handle. Pressure by other organizations, he added, "generally serves to muddle the issue." In summary, General Echols stated that Airborne Transport had been given sufficient information by Generals Vanaman and Branshaw to enable them to submit a formal and complete proposal. The advisability of awarding an experimental contract would be determined by the Materiel Center's evaluation of such a proposal.[81a]

81a. Ibid.

On the same day that General Echols sent his report to the Director of Military Requirements, General Chidlaw reiterated the attitude of the Materiel Command in a letter to Colonel Dent. It would be necessary, he said, to treat the Airborne Transport group courteously, "and with the same consideration given to all the other folks who think they know how to build gliders." Nevertheless, the Materiel Command would "refuse to be stampeded into dishing out a juicy experimental contract to this outfit" unless it appeared that the glider was definitely worth while, and this, General Chidlaw said, "I seriously doubt in view of Bowlus' past performance." Colonel Dent was assured that "unless General Echols sees fit to change our minds for us, we will continue on this basis."[82]

Throughout the summer of 1943 Wright Field heard rumors that the MC-1 was being built and that Major Blomquist of the Office of the Special Assistant on the Glider Program was acting as project engineer.[83] On 25 August, Richard duPont, Special Assistant for the Glider Program, showed General Arnold photographs of the MC-1 and explained "the circumstances under which it had been built." At that time duPont obtained General Arnold's approval of publicity for the glider "so long as it did not reveal the carrying capacity." In addition, duPont recommended that the MC-1 be procured as commercially approved equipment as in the case of the DC-3 transports.[84] About a week after his meeting with General Arnold, duPont carried photographs of the MC-1 to General

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82. Brig. Gen. B. M. Chidlaw, MC, Wash., to Col. Fred M. Dent, Airc. Lab., WF, 16 Feb. 1943, in ATSC 452.1, Bowlus.
83. Résumé of Happenings on XCG-16 Glider Project, 26 Oct. 1944, by Lewis J. Stone, Glider Br., in Corres., XCG-16, Airc. Lab.
84. "Report of Meeting with CG, AAF, 25 Aug. 1943," by Richard C. duPont, true copy in M&S, Airc. Proj. Br. Glider File, 4.211, Experimental, CG-16.

Echols and suggested that he would like to have a contract placed for 1,000 of the gliders, with the contract to be administered by the Department of Commerce.[85]

On 11 September came the dramatic announcement that Richard duPont and Colonel Ernest Gabel of the same office had been killed in a glider crash at March Field, Calif. The glider involved was the much disputed MC-1. Two days after the crash, the Western Procurement District notified the Materiel Command that the aircraft which crashed at March Field was a Bowlus commercial type glider "which was constructed apparently at the request of Mr. DuPont's office." Wright Field was also informed at that time that "a Major Blomquist from Mr. DuPont's office has acted as Mr. DuPont's representative at the factory."[86] A few weeks later, the General Airborne Transport Company listed its chief personnel for a Materiel Command glider report. Among other data submitted on Hawley Bowlus was the brief statement: "Associated with Richard duPont in the building and development of gliders."[87]

The MC-1 crash, which resulted in the death of four out of six passengers in the glider,[88] apparently had little deterrent effect on either the promotion of the company's proposal or recognition of the promoters' claims.[89] In October 1943 it was announced that the Airborne Command had a requirement for large transport gliders. The staff office of OC&R in Washington asserted that the most promising of the high

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85. Memo for Gen. Chidlaw by Gen. Echols, 31 Aug. 1943, ibid.
86. TT HQB-56, C/S, MC, to AC/AS, M&D, 13 Sep. 1943, in Corres., XCG-16, in Airc. Lab.
87. "Glider Report," Vol. VI, sec. on XCG-16.
88. TT HQB-56, C/S, MC, to AC/AS, M&D, 13 Sep. 1943.
89. See memo for Gen. Chidlaw by Chief, Development Eng. Br., M&D, 20 Oct. 1943, in M&S, Airc. Proj. Br. Glider File, 4.211, Experimental, CG-16.

performance gliders was the Bowlus model manufactured by the Albert Criz Company of California.[90]

Criz said he could build 400 Bowlus-Criz gliders per month in the third quarter of 1944. This would be accomplished, he said, with 3,000 direct employees. The Chief of the Production Division at Wright Field replied that the Materiel Command had demonstrated to Criz "by simple arithmetic" that such a program would require 20,000 direct workers. The execution of the Criz proposal would be "one of the most remarkable production feats in all [the] history of aircraft production."[91]

Again Washington officials took a different view of the matter. On 1 November Maj. Gen. B. M. Giles, Chief of Air Staff, told General Arnold that "plans submitted by Mr. Criz indicated a remarkable production possibility." There was a requirement, he said, for 200 of the Bowlus-Criz gliders by the middle of March 1944.[92] On the day that General Giles made this report, the staff office for Materiel, Maintenance, and Distribution (MM&D) notified Wright Field that the issue concerning the MC-1 had reached a climax. Recognizing that the advocates of the Criz proposal were determined to cause the award of a contract for production articles of the glider, MM&D had issued a vehement counterclaim, pointing out that the MC-1 was unproved, would interfere with existing aircraft programs, and could not be produced in quantities when needed. "In fact we talked ourselves blue in the face but General Giles

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90. R&R, Brig. Gen. H. A. Craig, AC/AS, OC&R, to AC/AS, MM&D, 4 Oct. 1943, copy in "AAF Glider Program, Prod. Proc.," App. P.
91. IOM, Col. Orval R. Cook, Chief, Prod. Div., to Brig. Gen. F. O. Carroll, Chief, Eng. Div., et al, 2 Nov. 1943, ibid.
92. TT AFDMA-1-277, MM&D to MC, WF, 1 Nov. 1943, ibid.

backed up by Gen. Kuter [AC/AS, Plans] ruled that the tactical situation warranted this tremendous gamble. . . ." The Chief of Air Staff directed the procurement of approximately 1,000 Bowlus-Criz gliders. General Giles then called in Criz and told him that they would receive a quantity order but that the gliders would have to be built outside the general Los Angeles area.[93] Five days later the Chief of the Engineering Division at Wright Field said: "In view of the fact that the Chief of the Army Air Forces has made the decision that the Bowlus-Criz glider will be placed in production it is imperative that the Engineering Division fulfill all duties cheerfully and wholeheartedly in all matters connected with this project. . . ."[94]

On 9 November the Chief of Air Staff directed the Materiel Command to cancel all arrangements for the 1,000 production model Bowlus-Criz gliders and to procure instead three experimental models of the MC-1.[95]

Letter contract ac-1666 with the General Airborne Transport Company was approved 13 November 1943. It called for the construction of two flight-test articles and one static-test article of the MC-1, AAF XCG-16 glider.[96] When the contract was awarded, Criz said he could deliver the gliders not later than February 1944.[97]

While arrangements for the experimental contract were being completed,

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93. TT AFDMA-1-273, MM&D to MC, WF, 1 Nov. 1943, ibid. See also memo for DC/AS by Brig. Gen. E. M. Powers, M&S, 26 July 1944, in AAG 452.1D, Gliders; and Chief, Prod. Dr., MM&D, to CG, MC, Attn. Tech. Exec., 8 Nov. 1943, in M&S, Airc. Proj. Br. Glider File, 4.211, Experimental, CG-16.
94. ICM, Chief, Eng. Div., to Chief, Airc. Lab., 6 Nov. 1943, in ATSC 452.1, Bowlus-Criz Glider.
95. TT C/AS 1306, C/AS to MC, WF, 9 Nov. 1943, copy in AAF Glider Prog., Prod. Proc., App. P.
96. Contr. W33-038 ac-1666; Résumé of Happenings on XCG-16, 26 Oct. 1944.
97. Ibid.

the Materiel Command learned that Maj. Felix duPont, Coordinator of the Glider Program at AAF Headquarters, had stated that the AAF expected to order "a large number of Bowlus-Criz gliders."[98] The promotion activities of Albert Criz were apparently still in full swing and probably constituted a major factor in the obvious enthusiasm of officials backing the XCG-16. In February 1944 General Branshaw of the Materiel Command noted that Criz was a "dynamic individual," and confessed that "spending a few days in the company of Mr. Criz is a somewhat exhausting experience." The man's enthusiasm for the glider was "somewhat infectious," but he was "optimistic in analyzing production possibilities."[99]

By May 1944 it was apparent that deliveries on the experimental contract would be greatly delayed and that the original estimated contract price of $625,000 was a highly optimistic guess. An overrun (production beyond authorized number of articles) of approximately $663,000 was approved in Washington in May, and when the letter contract with General Airborne was superseded by the formal cost-plus-a-fixed-fee contract ac-1666 on 14 June, the contract price was set at $1,264,684.27. In October the Procurement Division, Materiel Command, approved an additional overrun, making the total price $2,150,000.[100]

Flight tests of the XCG-16 were conducted at Oxnard, Calif., and in August 1944 tests were continued at the Clinton County Army Air Field.[101]

By November the ATSC was openly critical of progress on the XCG-16.

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98. Maj. Gen. Charles E. Branshaw, CG, MC, to MM&D, 13 Nov. 1943, in AAG 452.1D, Gliders.
99. Maj. Gen. Charles E. Branshaw to Prod. Br., MM&D, 26 Feb. 1944, in M&S, Airc. Proj. Br. Glider File, 4.1119, Airborne Transport.
100. Ibid.; Finance Sec. File of Payments.
101. TT ENG-1159, MC to AAFRR, General Airborne Transport Co., 14 Aug. 1944, ATSC 452.1, General Airborne Transport Co.

Production Section notified the staff office for Materiel and Services (M&S) in Washington that "the costs involved in the design and construction of the XCG-16 gliders by General Airborne to date are more than three times the original estimate and delivery is considerably behind schedule."[102] Even more significant was a growing dissatisfaction with the glider itself. Following a series of flight tests at Clinton County Army Air Field, the XCG-16 was submitted to the AAF Board at Orlando, Fla., for a detailed evaluation. It was found that the glider had inadequate crash protection, unsatisfactory loading ramps, insufficient personnel exits, awkward location of flight equipment, "critical lateral loading," and "extremely restricted pilot visibility." On 2 November the Board declared the XCG-16 "operationally and tactically unsuitable." At the end of November the Engineering Division, Wright Field, notified M&S that the XCG-16 contract was approximately 80 per cent complete, that current expenditures on the contract were more than $3,000 per day, and that the AAF Board had determined that the glider itself was "of no tactical use."[103] In view of this evidence, Wright Field recommended cancellation.[104] On 30 November ATSC notified General Airborne of the immediate cancellation of the contract for the XCG-16.[105] As of 31 October the contractor had received $771,227.15, and the unpaid obligation on the contract was $1,378,772.85.[106]

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102. TT TSBPR3H-11-91, Lt. Col. E. W. Dichman, Prod. Sec., WF, to AC/AS, M&S, Attn. Maj. W. D. Hoyt, 14 Nov. 1944, in Glider and Misc. Airc. Br., Prod. Sec., WF.
103. "Preliminary Rept. of Operational and Tactical Suitability Test of the XCG-16 Glider, Project No. 4084G4521," 2 Nov. 1944, by AAF Board; and Analysis of XCG-16, Nov. 1944, unsigned document, in Corres., XCG-16, both in Airc. Lab., WF.
104. TT TSESE-2-11-516, Eng. Div., WF, to AC/AS, M&S, 30 Nov. 1944, in Contr. Files, Corres., Contr. ac-1666.
105. Telg. TSRTE-5-11-51, ATSC to General Airborne, et al, 30 Nov. 1944, Corres., XCG-16, Airc. Lab., WF.
106. Finance Sec. File of Payments. Termination negotiations were in progress at the date of this study, as of May 1945.

XCG-17. In the fall of 1944 the AAF was faced with the problem of delivering large quantities of supplies from India to China over "The Hump." Sufficient cargo airplanes were not available. It was proposed by OC&R that the use of cargo gliders might improve this situation.

At the request of AMSD a preliminary design study was made by the Materiel Command with regard to converting a C-47 airplane into a glider for this type of mission. As a result of this study the Materiel Command found that a pay load of 14,500 pounds could be transported in the C-47 airplane converted as a glider and that the C-54 airplane was an ideal tug for it.

A C-47 airplane was finally made available to the Materiel Command in April 1944 to be converted into an XCG-17 glider. The conversion was accomplished at Clinton County Army Air Field by military personnel. Therefore, no contract was issued to produce this glider.

Flight tests with the XCG-17 glider during the summer of 1944 with the C-54 airplane as a tug proved that the study was accurate and that the combination was satisfactory.

As of November 1944 no requirement for quantities of the XCG-17 glider was stated. By that time the supply situation in the CBI theater had eased considerably.[107]

Assault Gliders

In 1942 AAF personnel became actively interested in the possibility of developing a glider armed for the purpose of assaulting enemy-held

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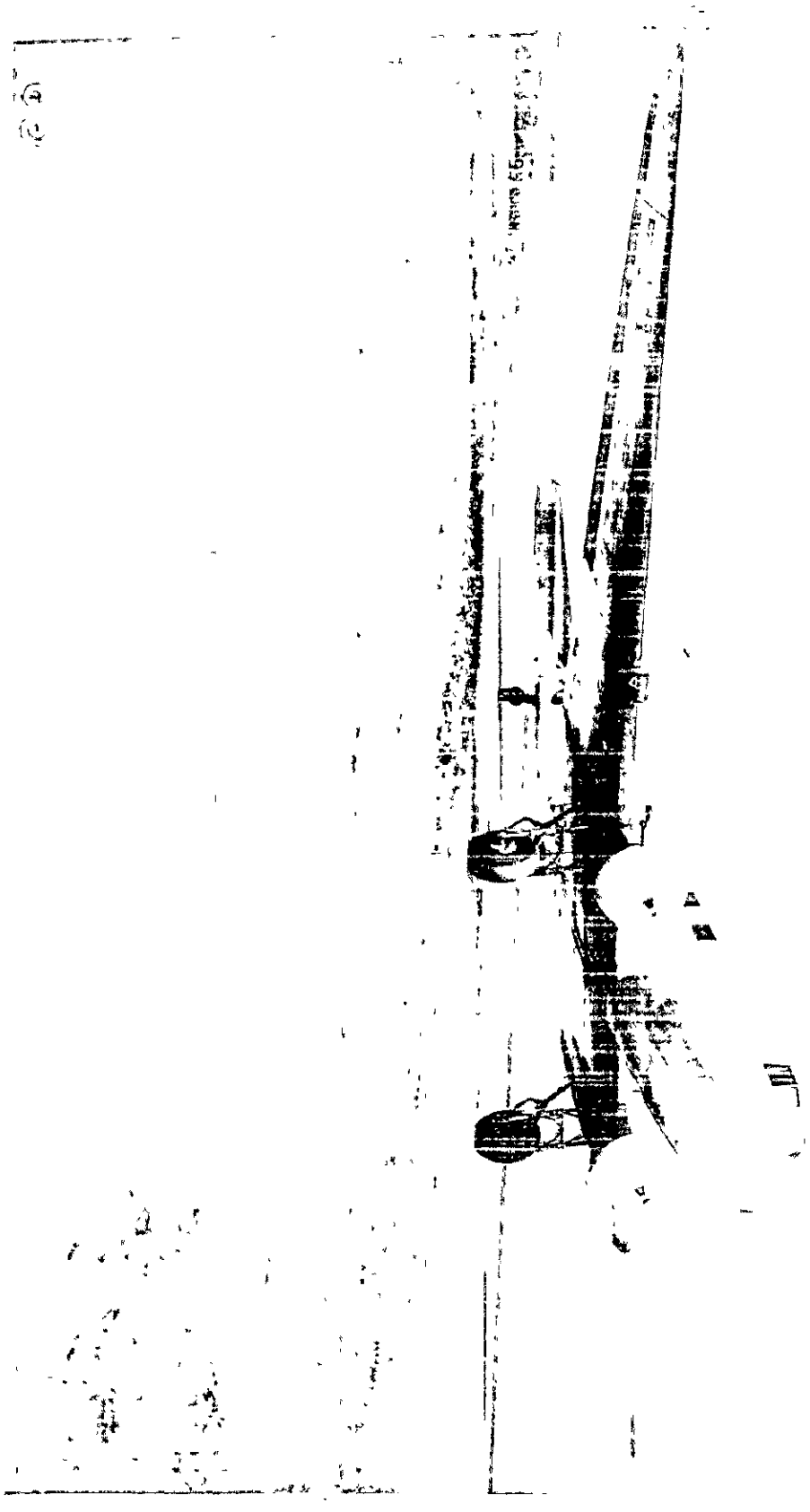
107. TI-1570, 16 Nov. 1943; IOM, Chief, Airc. Lab. to DC/S, HC, AF, 25 Nov. 1943; Airc. Lab. Weekly TT, 22 June 1944; all in Airc. Lab., Eng. Div.; interview, Maj. W. C. Lazarus, 7 Dec. 1944.



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AFSC Modification XC5-17

positions. In June the Director of Military Requirements announced a requirement for an assault glider, and two weeks later Lt. Gen. L. J. McNair, Commander of the Army Ground Forces, recommended the development of such aircraft.[108] In August an official of the I Troop Carrier Command expressed a dissenting opinion. He said that gliders were not considered "battle wagons of the air with offensive power of their own."[109] Nevertheless on 19 October 1942, CTI-976 directed the procurement of experimental assault gliders.[110]

In the meantime Wright Field had gone ahead with preliminary studies. In July the Aircraft Laboratory evaluated an assault glider design prepared by the AGA Aviation Corporation and recommended that "no further consideration be given to the development of an assault glider." In August the Aircraft Laboratory reiterated its opposition to the development of such aircraft.[111]

In September Materiel Command Headquarters in Washington warned the Materiel Center that "assault gliders are going to be forced upon us." The Ground Forces were actively supporting the assault glider project.[112] The following month the Director of Military Requirements submitted approved military characteristics for such aircraft,[113] and in November the Materiel Center began an intensive search for contractors.

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108. "Resume of AAF Glider Prog.," p. 3.
109. C/S, I TCC, 25 Aug. 1942, quoted in "AAF I Troop Carrier Command Glider Program," Vol. I, p. 3.
110. "Resume of AAF Glider Prog.," p. 3; Lt. Gen. L. J. McNair, to CG, AAF, 4 July 1942, in AAG 452.1B, Gliders.
111. MC Memo Rept. EXP-M-51/AD1012, Add. No. 1, 25 July 1942, and MC Memo Rept. EMG-M-51/4561-1-2, 6 Aug. 1942, quoted in "Glider Report," Vol. III, Pt. 1, p. 97.
112. TT EX-932, AC/S (E), MC, Wash., to EES, Mat. Cent., 3 Sep. 1942, ibid., pp. 97-98.
113. AFDMR to CG, MC, Wash., 15 Oct. 1942, ibid., pp. 97-98.

Between 6 November 1942 and 15 January 1943, 17 companies were contacted. Each prospective manufacturer was given a copy of the type specification for an 8-place assault glider. Of the firms contacted, only the Timm Aircraft Company at Los Angeles and the Christopher Aircraft Company at St. Louis showed any interest in the proposal. Early in February 1943, fixed-price contract ac-37433 for three XAG-1 assault gliders was awarded the Christopher Company.

Near the end of February the Materiel Center again tried to eliminate the assault glider project. The Engineering Division insisted that the gliders would have no tactical value and that "considerable time, effort and Government funds" could be saved by canceling the entire assault glider program. This expression of opposition brought a trenchant reply from the Materiel Command: "Neither the Materiel Center nor the Materiel Command has a leg to stand on asking for reconsideration based on the belief that assault gliders have no 'tactical value'." Prerogatives of these organizations, it was emphasized, extended only to technical and production considerations, and the Materiel Command had "no intention of opening up this subject" unless sound technical reasons instead of tactical judgments were offered pertaining to the impossibility of developing assault gliders.[114]

On 22 May the Materiel Center awarded a letter contract (ac-40068) for flight and static test models of an XAG-2 assault glider to the Timm Aircraft Company.[115] The XAG-2 was designed as a low-wing cantilever

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114. Chief, Eng. Div., WF, to MC, Wash., 27 Feb. 1943, and C/S (E), MC, to Chief, Eng. Div., WF, 5 March 1943, ibid., pp. 106-07.
115. Ibid., p. 109.

monoplane having a gross weight of 8,500 pounds, a towing speed of 240 miles per hour, and places for eight men, including the pilot and co-pilot; it was to carry two .30-caliber waist guns and a Martin twin .50-caliber gun turret placed behind the pilot and co-pilot. Armor plate protection was provided for the pilot and co-pilot. The glider was of all-wood construction. The XAG-1 manufactured by Christopher was of similar design. Both models were designed for the purpose of carrying Airborne Infantry in attacks on enemy-held positions. The fire power of the gliders would assist in covering landings.[116]

The Christopher Company delivered a wind tunnel model to the AAG-1 in May 1943, and in June the mock-up of the glider was approved. Unfortunately, a great deal of effort was expended by both the contractor and the Materiel Command in a series of disputes relating to delivery dates, contract requirements, and design features. One of the chief points of contention was the contractor's claim that it was difficult to secure prompt and accurate information relating to technical matters. The Chief Engineer of the Christopher Company forwarded a severe protest in this matter to the Chief of the Aircraft Laboratory in June. He insisted that it had taken the contractor two months to obtain data on a mounting ring, and said the attempt to secure the information involved 12 letters and 13 telegrams. Three months' effort, 22 letters, and 6 telegrams, he said, were required to obtain information about .30-caliber twin gun adapters. By way of proof, he added that "copies of these letters are in your files." The Christopher letter was forwarded to

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116. Ibid., pp. 109, 111.

the Glider Branch for "necessary" and "proper" action. In return, the Materiel Command was irritated by the difficulty encountered in trying to pin the contractor down to agreement on, as well as fulfillment of, certain contract requirements, and the contractor's letters were so vague that it was often impossible to frame an adequate reply.[117]

In the meantime Timm was making good progress on the XAG-2. The report on the Timm mock-up was made by the Engineering Division on 22 July, and the following month the contractor delivered a wind tunnel model.[118] Evidence of continued opposition to the assault glider project was provided in August by Brig. Gen. B. W. Chidlaw in MM&D, who said, "I thought at the very start of this project and still think this whole idea of Assault Gliders with turrets, generators, radio, etc., is nothing but a 'damned fool idea'." General Chidlaw believed that the assault glider project was "a whim of the late Major Barringer" and suggested that MM&D take up the matter with the Special Assistant on the Glider Program in an effort to "spike" the entire assault glider program.[119] On 2 September 1943 the Office of the Special Assistant notified MM&D that there should be "no further development of assault gliders."[120] On 17 September wind tunnel tests on the XAG-2 were discontinued, pursuant to verbal instructions from MM&D.[121] On 11 October the Materiel

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117. Chief Engineer, Christopher Airc. Co. to Chief, Airc. Lab., 25 June 1943, and Chief, Proc. Div., WF to Christopher, 24 July 1943, in Contr. Files Corres., Contr. ac-37433.
118. Chief, Eng. Div., MC, WF to CG, ASC, 24 Sep. 1943, in ATSC 452.1, Assault Gliders; Airc. Lab. Weekly TT, 26 Aug. 1943.
119. IDM, Brig. Gen. B. W. Chidlaw to Col. J. F. Phillips, MM&D, 2 Aug. 1943, in AAG 452.1C, Gliders.
120. Daily Diary, Special Asst., Glider Prog., 2 Sep. 1943, in AAG 319.1.
121. Airc. Lab. Weekly TT, 17 Sep. 1943.

Command was directed to cancel the XAG-1 and XAG-2 projects, and the Requirements Division of CC&R said there was no requirement for assault gliders.[122] By 31 October 1944, Timm had received $213,572.49 for work accomplished on the XAG-2, and Christopher had been paid $160,775. There was an unpaid obligation of $157,275 on the Christopher contract, which was subject to negotiation.[123]

Powered Gliders

In the spring of 1943 the Materiel Command initiated a program for the development of powered gliders. As originally conceived, these aircraft were to be standard model gliders with low-power engines added, and their classification as powered gliders rather than cargo airplanes was derived from the fact that they retained the appearance, function, and many of the characteristics of ordinary gliders. As more advanced designs for powered gliders came into being, distinction between that type of aircraft and cargo airplanes became less apparent. Probably the chief difference was that powered gliders were designed to carry bulky cargo at lower speeds and to land in small, unprepared areas, while cargo airplanes operated at higher speeds and required prepared runways.

The first contract for powered gliders was placed in April 1943 with the Northwestern Aeronautical Corporation of Minneapolis, one of the manufacturers of the CG-4A. Supplement 7 to Northwestern's production contract ac-26936 provided for the installation of two 125-horsepower

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122. TT AFDMA-2-431, MM&D, to MC, WF, 11 Oct. 1943, copy in "Glider Report," Vol. III, Pt. 1, p. 112.
123. Finance Sec. File of Payments.

Franklin engines on a CG-4A.[124] The resultant XPG-1 was delivered in May,[125] but was later destroyed by a tornado at the Clinton County Army Air Field. The Glider Branch announced in July 1943 that the project would be dropped "inasmuch as it is considered that the XPG-1 glider has no tactical use."[126] The XPG-1 project cost the government approximately $52,000.[127]

A similar project was carried out in 1943 by the Ridgefield Manufacturing Corporation of Ridgefield, N. J., under contract ac-26597. In this instance a CG-4A was converted to an XPG-2 by the addition of two 175-horsepower Ranger engines, model 6-440O-2, with Sensenich 86R61 propellers.[128] This glider was delivered in July 1943,[129] and was flown from the Ridgefield plant to Wright Field under its own power.[130] In August 1943 the Aircraft Laboratory pronounced the XPG-2 "ready for production if desired by higher authority," but no production contracts for this glider were awarded.[131] Interest in the XPG-2 was revived in August 1944, when the Air Service Command of the U. S. Strategic Air Forces in Europe expressed a desire for a low-powered, short-range transport airplane for use in the United Kingdom. Such an aircraft would eliminate the use of partially loaded C-47's on short hauls. In October and

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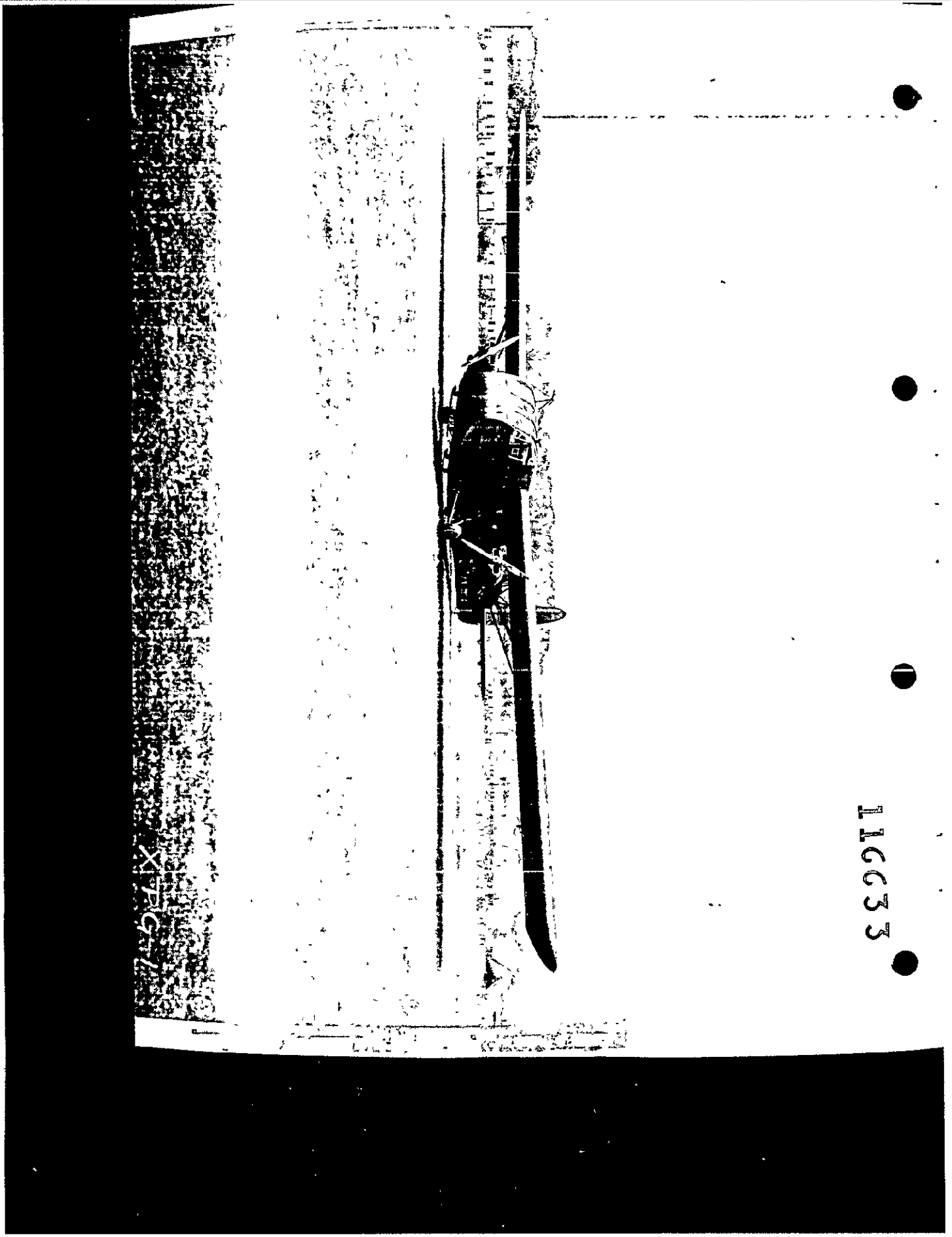
124. "Glider Report," Vol. I, photo. sec., XPG-1.
125. WS-378, Airc. Acceptances, 173.
126. Airc. Lab. Weekly IT, 22 July 1943.
127. "Glider Report," Vol. I, photo sec., XPG-1; ICM, Proc. Div., WF, to AC/AS, M&S, Attn: Brig. Gen. D. M. Powers, 24 Oct. 1944, copy in AT3C Hist. Office. The cost of the XPG-1 was derived by adding the engine installation costs to the price of the CG-4A glider used in the conversion.
128. "Glider Report," Vol. I, photo. sec., XPG-2.
129. WS-378, Airc. Acceptances, p. 173.
130. Airc. Lab. Weekly IT, 16 July 1943.
131. Ibid., 20 Aug. 1943.

[redacted]

Northwestern XFG-1



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November preliminary steps were being taken to provide 60 XPG-2 gliders for use in the European theater.[132] The XPG-2 was built at a cost of approximately $54,000.[133]

No further contracts for powered gliders were awarded until September 1944, when the Waco Aircraft Company was given a cost-plus-a-fixed-fee contract (ac-3163) for an XPG-3. This glider was to be a CG-15A with two Jacobs R-755-9 engines. The contract also called for the construction of two XPG-3-type engine nacelles suitable for installation on a CG-4A. It was estimated that the XPG-3 would cost $126,000, the nacelles $14,000.[134]

Negotiations were also under way with Waco in October 1944 for the development of a low-powered transport plane or a powered glider to be modified from the 30-place CG-13A.[135]

Miscellaneous Glider Types

Beginning in December 1941 the Materiel Command procured a number of experimental tow-target and bomb gliders. The Bristol Aeronautical Corporation of New Haven, Conn., built 21 C-1 tow-target gliders at a total cost of approximately $76,000 between January 1942 and July 1943. In May 1942 ten XBG-1 radio-controlled bomb gliders were delivered by the Fletcher Aviation Corporation of Pasadena, Calif. In addition to the $87,000 paid for these gliders, the government allowed Fletcher

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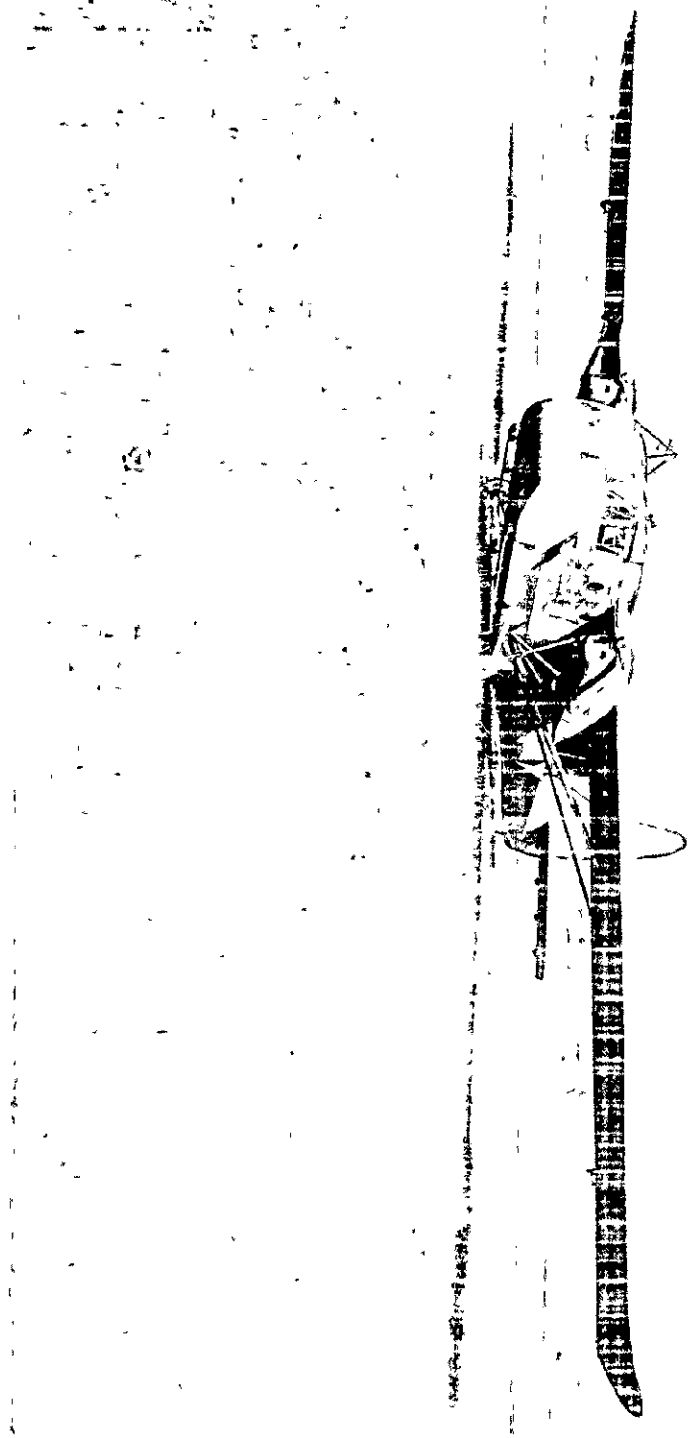
132. Memo Rept. TSEAL-2-4563-3-1, Add. No. 2, 30 Nov. 1944, in M&S, Airc. Proj. Sr. Glider File, 4.321, Experimental, XPG-2.
133. "Glider Report," Vol. I, photo. sec., XPG-2; ICM, Proc. Div., ATSC, to AC/AS, M&S, Attn. Brig. Gen. E. M. Powers, 24 Oct. 1944. Cost derived as in case of XPG-1.
134. Contr. W33-038 ac-3163.
135. Airc. Lab., WF, to Waco, 10, 30 Oct. 1944, in ATSC 452.1, Waco Airc. Co.

Ridgefield XPG-2



$16,546 for work accomplished on a contract for XBG-2 bomb gliders. No XBG-2's were delivered and the contract was canceled in September 1942.[136]

Another project undertaken by the Aircraft Laboratory was the development of the XFG-1 fuel glider begun in 1943. In October of that year a cost-plus-a-fixed-fee contract for the XFG-1 was given to the Cornelius Aircraft Corporation of Dayton, Ohio. The XFG-1 was a non-conventional tailless glider with swept forward wings.[137] The Aircraft Laboratory announced in 1943 that the XFG-1 would be used to "evaluate this aerodynamic configuration for fighter plane design" and to "test the feasibility of extending the range of cargo and bombardment aircraft by means of a trailing fuel glider."[138]

The Cornelius Corporation did the preliminary design work on the XFG-1 and made the stress and weight analyses and balance diagram. Construction of the glider was subcontracted to the Spartan Aircraft Company of Tulsa.[139] Wind tunnel and structural tests of the glider were conducted during the summer of 1944, and on 11 October the XFG-1 made its first flight. As of 31 October 1944, payments to Cornelius on this contract totaled $249,989.93.[140]

A British Hamilcar transport glider was also being tested at the Clinton County Army Air Field late in 1944.[141]

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136. "Glider Report," Vol. III, Pt. 1, pp. 133-36; Finance Sec. File of Payments.
137. Actg. Chief, Eng. Div., MC, WF, to Director of Aeronautical Research, NACA, 7 June 1944, in ATSC files, Confidential Proj. MX-416.
138. IOM, Chief, Airc. Lab., MC, to Chief, Legal Br., MC, 8 July 1943, ibid.
139. Pres., Cornelius Airc. Corp. to MC, WF, Attn. Col. M. F. Cooper, Eng. Div., 5 Feb. 1944, ibid.
140. IOM, Actg. Chief, Eng. Div., MC, WF, to MC Liaison Officer, NACA, 21 July 1944; Telg., Eng. Div. to Cornelius, 2 Sep. 1944, ibid.; Airc. Lab. Weekly TT, 20 Oct. 1944; Finance Sec. File of Payments. Further tests and accumulation of data were in progress at the date of this monograph.
141. Airc. Lab. Weekly TT, 24 Aug. 1944.

Towplanes

On 1 April 1942 General Arnold directed the Materiel Command to make a study and perform tests to determine the suitability of combat and transport aircraft as tugs for towing gliders.[142] Wright Field conducted extensive tests of towplanes from the summer of 1942 on, and by October 1944 the P-38, C-47, C-53, C-60, C-46, A-25, B-25, and "any four engine bomber or transport" were listed as suitable for towing the 15-place CG-4A and CG-15A gliders. The 30-place CG-13A could be towed by a C-46, C-54, B-17, or B-24.[143] By the end of November 1944, however, tactical considerations as well as the performance and availability of the aircraft had made the C-47 the outstanding towplane. In the European Theater of Operations the C-47 was the only plane in use as a tug for AAF gliders.[144]

Summary

For the development of suitable tactical gliders the Materiel Command awarded 22 contracts to 16 different companies between April 1941 and 31 October 1944. In addition the Aircraft Laboratory modified a C-47 transport and evaluated foreign gliders. Including unpaid obligations on completed and canceled contracts, this program had cost the government approximately $6,200,000 in payments to contractors as of 31 October 1944. In addition, 21 tow-target gliders were procured

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142. Gen. Arnold to MC, Wash., 1 April 1942, copy in "Resume of AAF Glider Prog.," Exhibit B.
143. Airc. Lab. Weekly TT, 3, 17, 24 Sep. 1943, 24 Aug. 1944; ICM, Proc. Div., WF to AC/AS, M&S, Attn. Brig. Gen. E. M. Powers, 24 Oct. 1944.
144. ATSC Memo Rept. TSEAL-2-4561-1-12, 30 Nov. 1944. An account of the towplane test program of the I Troop Carrier Command is included in "I TCC Glider Prog.," Vol. I, pp. 134-43.

at a cost of $76,000.[145]

Four production model tactical gliders were developed: the CG-3A, CG-4A, CG-15A, and CG-13A. The XPG-2 was also approved for production but no procurement was authorized, and the converted C-47 (XCG-17) was considered to have tactical utility if required. In addition, the XCG-10A was being favorably considered at the date of this study (May 1945), and work on the XCG-14, XFG-1, and XPG-3 was still in progress.

Of the 22 contracts let, 7 were completed, 10 were canceled, and 5 were in progress at the end of October 1944. Of the cancellations, two -- the XAG-1 and XAG-2 assault gliders -- were canceled as a result of a decision by higher authority that no requirement existed, and the remainder were terminated because of the inability of the contractor to meet delivery requirements or the failure of completed articles in test.

The development of tactical gliders was one of the most difficult tasks undertaken by the Materiel Command. Working with few precedents as a guide, and handicapped by provisions excluding the larger aircraft companies from participation in the program, engineers of the Aircraft Laboratory were nonetheless asked to develop acceptable gliders in the shortest possible time. The pressure under which the Glider Branch worked is evidenced by the fact that the urgent requirements for gliders prompted the award of 11 production contracts for the CG-4A before the first flight-test XCG-4 was delivered to Wright Field. In addition to these factors, the problems of the Materiel Command were aggravated by

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145. Finance Section File of Payments and figures from "Glider Report" as quoted earlier in this chapter were used to determine total payments.

changing requirements, as in the case of the assault gliders, and by the activities of AAF organizations other than the materiel establishment. The campaign carried on in favor of the Bowlus-Criz MC-1 glider was especially troublesome. The Bowlus-Criz case brought a sharp protest from Colonel Dent, who complained that "personnel of Commands outside the Materiel Center have repeatedly made the development problem difficult by dealing directly with prospective contractors, gathered questionable data, and deliberately excited people in Washington without taking the trouble to determine the accuracy of the data." The elimination of such activities declared Colonel Dent would "permit this office to devote full attention to the development of sound engineering projects instead of preparing voluminous reports contradicting ridiculous claims."[146] The stand taken by Wright Field in the Bowlus-Criz case is at least supported by the adverse report of the AAF Board, which in effect substantiated much that the Materiel Command had said when the MC-1 was first proposed. These problems are more fully discussed later in relation to other aspects of the glider program.

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146. "Glider Report," Vol. VI, sec. on XCG-16.

Chapter IV

PROCUREMENT OF TRAINING GLIDERS

Although the quantity production of training gliders was a task more limited in scope than the production of tactical gliders, the urgent need for trainers made that production project one of the most critical problems of the glider program. Glider pilots were needed to carry on development work and to serve as a corps of instructors for the tactical glider training program. The Army had had almost no experience with gliders, and as a result military pilots were not available for even the preliminary phases of the program. The production of training gliders became, therefore, a vital function in the glider program.

Schweizer TG-2

The first AAF production glider procurement was authorized by Technical Instruction (TI)-855 on 29 August 1941. This directive called for the procurement of 18 2-place gliders, and resulted in a contract with the Schweizer Aircraft Corporation of Elmira, N. Y. The Schweizer's XTG-2 was completed in September, and the 18 gliders ordered were TG-2's, bought on contract ac-21942 which was approved 24 October 1941. In the summer of 1942 the contract was increased by eight gliders to use materials left after the delivery of the original quantity.[1]

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1. IOM, Brig. Gen. K. B. Wolfe, Chief, Prod. Div., Mat. Cent., to MC, Wash., Attn. C/S, 22 Aug. 1942, copy in "AAF Glider Prog., Prod. Proc.," App. C; "Resume of AAF Glider Program," p. 2.

The Schweizer Corporation had also the distinction of delivering, in February 1942, the first production article in the glider program. The contract was completed with the delivery of the twenty-sixth glider in July 1942. The TG-2's cost the government $2,864 per glider, or a total of $74,461.81.[2] These gliders were used in the first AAF glider training program.[3]

Laister-Kauffmann TG-4A

During the latter part of 1941 and through most of 1942 the Laister-Kauffmann Aircraft Corporation was working on its 2-place XTG-4. Early in 1942 before the completion of the experimental contract, Wright Field found the glider as modified by Materiel Division engineers suitable for production. On 4 March a contract (ac-25850) for 75 TG-4A's was approved, and in May a second contract (ac-28995) for 75 additional gliders was awarded.[4] Laister-Kauffmann made the first delivery in July 1942, and in June 1943 both contracts were completed. The unit cost of the TG-4A was approximately $4,062. As of 31 October 1944 payments on these contracts totaled $609,090.62, and the government owed Laister-Kauffmann an additional sum of $213.75.[5]

Schweizer TG-3A

The Schweizer XTG-3, a wooden adaptation of the TG-2, was the third training glider approved for production. On 24 March 1942 contract ac-26238 with Schweizer was approved calling for 75 TG-3A's. A contract

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2. WS-378, Airc. Acceptances, p. 178; Finance Sec. File of Payments.
3. IOM, Gen. Wolfe to MC, Attn. C/S, 22 Aug. 1942.
4. Contr. W535 ac-25850 and W535 ac-28995.
5. WS-378, Airc. Acceptances, p. 179; Finance Sec. File of Payments.

supplement increased the quantity to 110 in June. First deliveries were made in August and the contract was completed in July 1943, at a cost of $440,416.11, or approximately $4,004 per glider.[6]

Air Gliders TG-3A .

On 4 June 1942 Air Gliders, Inc., of Barberton, Ohio, was formed to manufacture airplane parts and gliders for the AAF. The three chief stockholders of the corporation were the Sun Rubber Company, the Hamlin Metal Products Company, and the Baker-McMillen Company; and various officers of these concerns held executive positions in Air Gliders. The president of Air Gliders was T. W. Smith, general manager of Sun Rubber; Air Gliders' treasurer was L. W. Hamlin, president of Hamlin Metal Products; J. Sperry, general manager of Baker-McMillen, served as vice president; and the secretary, J. Jarboe, was an Akron attorney.[7]

The organization of the Air Gliders corporation coincided with a search by the AAF for an additional source of supply for the TG-3A, and on 15 June 1942 CTI-712 directed the purchase of 50 of these gliders from the newly formed company.[8] Acting under this instruction, Wright Field negotiated a cost-plus-a-fixed-fee contract. The procurement was opposed, however, by Maj. E. W. Dichman, Chief of the Glider Unit

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6. Contr. W535 ac-26238; MS-378, Airc. Acceptances, p. 179; Finance Sec. File of Payments; IOM, Actg. Chief, Fiscal Br., Proc. Div., WF to Chief, Proc. Div., WF, 29 March 1943, in ATSC Hist. Office.
7. "Glider Report," Vol. II, Pt. 1, sec. on Air Gliders; memo to Chief, Tr. & Trans. Br., Mat. Cent., by Maj. E. W. Dichman, 14 Aug. 1942, Copy in "AAF Glider Prog., Prod. Proc.," App. N.
8. "Resume of AAF Glider Prog.," p. 3.

of PLS,[9] who pointed out in August that Air Gliders had no facilities available. "It seems apparent," he said, "that this firm is organized for the specific purpose of getting the Government to set them up in the aircraft business."[10] A few days later the Production Division lodged a further protest with the Materiel Command in Washington: "There appears to be little justification for the contract held by Air Glider... This company appears to be still on paper." The Glider Unit of the Production Division recommended that the contract be canceled.[11]

The directive to procure was not rescinded, and on 11 September the contract (ac-29755) for 50 TG-3A's was formally approved by the Chief of the Materiel Center Contract Section.[12] On the same day Brig. Gen. B. E. Meyers told General Wolfe at Wright Field to withdraw Air Gliders from the list recommended for cancellation. General Meyers said such action was necessary "because Congressman [W.] Dow Harter was after General Echols."[13] Later, Mr. Jarboe of Air Gliders was notified by General Meyers' office that termination proceedings had been stopped.[14]

In the meantime Air Gliders staggered through the preliminaries of production and the delivery of a TG-3A appeared increasingly remote. The Schweizer Corporation had contracted with Air Gliders to furnish design data and engineering and production aid.[15] On 30 October Air

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9. As has been stated earlier, the function of procuring production gliders was transferred from the Engineering Division to the Production Division in May 1942. As head of the Glider Unit of the latter Division, Major Dichman became responsible for the administration of contracts for production gliders.
10. Memo for Chief, Tr. & Trans. Br. by Maj. Dichman, 14 Aug. 1942.
11. ICM, Gen. Wolfe to MC, Wash., Attn. C/S, 22 Aug. 1942.
12. Contr. W535 ac-29755.
13. Résumé of Negotiations with Air Gliders, in "AAF Glider Prog., Prod. Proc.," App. N.
14. Attachment to ICM, Asst. Chief, Fiscal Br., to Actg. Chief, Proc. Div., MC, WF, 28 April 1943, in ATSC Hist. Office.
15. ICM, Actg. Chief, Fiscal Br. to Chief, Proc. Div., Mat. Cent., 29 March 1943.

Gliders notified the Materiel Center that they could not make deliveries specified by Wright Field because the data to be submitted by Schweizer had not been received "in a completed form to date," and in addition the data which had been submitted were unreliable. "We have been required to completely re-engineer the glider," the firm added. Colonel Dichman later admitted that there were "a number of dimensional errors" in the Schweizer drawings and related that Air Gliders had to loft a TG-3A to get completely accurate dimensions.[16] There was ample reason, however, for doubting the ability of Air Gliders to make effective use of data after they were received and corrected. Facilities of the corporation were woefully inadequate, and procedures of the organization do not appear to have been efficient or vigorous. In spite of Air Gliders' insistence upon receiving a TG-3A for examination, shortly after one was delivered to the company a Materiel Center representative visited the facility and found the glider covered with canvas and stored in a hangar.[17]

During the fall of 1942 the Glider Unit of PES at Wright Field made repeated attempts to have the contract terminated. On 16 December the Materiel Command in Washington wired the Materiel Center approving cancellation, and two days later Wright Field notified Air Gliders of the termination of the contract. On 29 December the Materiel Command

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16. Air Gliders, Inc. to Mat. Cent., 30 Oct. 1942, and ICM, Lt. Col. E. W. Dichman to Chief, PES, Mat. Cent., 18 Jan. 1943, copies in "AAF Glider Prog., Prod. Proc.," App. N.
17. ICM, Gen. Wolfe to MC, Wash., Attn. C/S, 22 Aug. 1942; ICM, Col. E. W. Dichman to Chief, PES, Mat. Cent., 18 Jan. 1943, quoted in attachment to ICM, Asst. Chief, Fisc. Br. to Actg. Chief, Proc. Div., Mat. Cent., 23 April 1943, p. 4.

directed Wright Field to continue the contract and authorized advance payments of 50 per cent of the contract price.[18]

Given this further stay of execution, Air Gliders stumbled along through the early months of 1943, but no TG-3A's were delivered. By May termination of the contract was again under consideration. On 6 May, Jarboe, secretary of Air Gliders, telephoned Col. O. R. Cook, Chief of the Production Division at Wright Field, to inquire about the proposed termination. The record of the negotiations on the Air Gliders contract indicates that there was justification for Jarboe's resentment over the indefiniteness of AAF plans. He told Colonel Cook:

> You have killed our group up here, that is, you have killed our organization. We couldn't hold it. We have no money to pay them. We had nothing for them to do. You shut off our funds . . . , you can't run a business that way. We couldn't keep these people sitting around doing nothing waiting for you to decide and now I think about 90% of them have goneahead and been absorbed by another company so we have had to start off with green help again, except for a few key men.

Colonel Cook pointed out that Air Gliders had not given the Materiel Command very advanced notice that they would have an overrun on the contract, and as a result there was little time for the Command to study the case and authorize the overrun. To this Jarboe replied that his company had foreseen the overrun several months in advance but they did not report it quickly because John Schwinn of the Procurement Division, Wright Field, had told him, "Well don't bother about that, some of these contractors have had seven overruns." Jarboe said the company had also

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18. Ibid., pp. 1-4; TT, E-326, E-513, WC, Wash., to Contr. Sec., Mat. Cent., 16, 29 Dec. 1942, copies in "AAF Glider Prog., Prod. Proc.," App. N.

been told that an application for an increase to cover an overrun was "only a two or three day proposition."[19]

A study of the negotiations relating to Air Gliders leaves no doubt that much of the confusion lamented by company officials was not of their own making. But more significant than these problems was the composition of the corporation. Jarboe, perhaps unwittingly, touched on the key to the Air Gliders situation when he told Colonel Cook that the company had to perform a preliminary engineering task on the TG-3A and

> had to build up a production personnel while this re-engineering was going on and we weren't getting any production out of them. We couldn't. The only thing we could do was to train them. We taught them how to make ribs, we taught them how to use glue but we weren't getting in production.

In addition, he confessed that the company's original confidence in their ability to build gliders from someone else's drawings was due to an underestimation of the task.[20] In brief, Air Gliders was a corporation on paper when the contract was let. Admitting the dearth of eligible reliable companies available for the program, it is nonetheless questionable if the AAF had anything to gain by the award of a contract to a company known to have inadequate facilities, no working personnel, no manufacturing experience, and no corporate history.

The Air Gliders contract was finally canceled on 10 May 1943.[21]

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19. Phone transcript, J. Jarboe, Sec., Air Gliders, and Col. O. E. Cook, Chief, Prod. Div., MC, 6 May 1943, recorded in "Glider Report," Vol. III, Pt. 1, pp. 201-05.
20. Ibid.
21. Résumé of Negotiations with Air Gliders, in "AAF Glider Prog., Prod. Proc.," App. N.

One TG-3A which had been accepted by the AAF in April was finally delivered two months after the contract was terminated. This glider cost the government $415,421.36.[22]

Frankfort TG-1A

On 17 January 1942 CTI-460 directed the procurement of 2-place training gliders from the Frankfort Sailplane Company of Joliet, Ill.[23] The Frankfort XTG-1 development was completed in March 1942 and in May contract ac-28131 for 40 production model TG-1A's was approved. Deliveries were completed in November 1942 at a total cost of $111,016.20, or approximately $2,775 per glider.[24]

Aeronca TG-5, Taylorcraft TG-6, and Piper TG-8

Approximately 75 per cent of the gliders produced in the training glider program were conversions of small commercial aircraft as 3-place gliders. On 29 May 1942 TI-1130 and TI-1131 directed the procurement of 250 training gliders each from the Aeronca Aircraft Corporation and the Taylorcraft Aviation Corporation, and on 8 June 1942 CTI-703 directed the purchase of 250 gliders from the Piper Aircraft Corporation.[25]

Aeronca converted its high-wing cabin-model plane into the TG-5; Taylorcraft's model "D" commercial trainer became the TG-6; and Piper made its L4-H liaison plane into the TG-8.[26] Each of the three companies

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22. WS-378, Airc. Acceptances, p. 178; Finance Sec. File of Payments.
23. "Resume of AAF Glider Prog.," p. 2.
24. Contr. W535 ac-28131; WS-378, Airc. Acceptances, p. 178; Finance Sec. File of Payments.
25. TI-1130 and TI-1131, 29 May 1942, and CTI-703, 8 June 1942, copies in "AAF Glider Prog., Prod. Proc.," App. B.
26. "Glider Report," Vol. I, p. 76.

was given a contract for 250 gliders, later increased to 253. (Three gliders on each contract were classified experimental.)

Aeronca's contract ac-30103 was approved 8 July 1942, and all but one of the TG-5's were delivered prior to December. The contract was not officially completed until June 1943, when the last glider was delivered. As of 31 October 1944 Aeronca had received $561,612.13, and the government still owed the contractor $4,069.20. The unit price of the TG-5 was approximately $2,236.

The Taylorcraft contract ac-29841 was approved 23 July 1942, and deliveries were completed in November at a total cost of $656,754.05, or $2,596 per glider.

Contract ac-31398 with Piper was approved 19 August 1942, and deliveries were completed in April 1943. The unit cost of the TG-8 was approximately $2,108; payments to Piper totaled $533,435.23.[27]

The conversion of these light airplanes was a major success in the training glider program. In addition to the suitability of the gliders it is worthy of note that for a sum equal to one-half the total payments made in the training glider production program, Aeronca, Taylorcraft, and Piper manufactured three-fourths of the gliders.

Gliders Purchased from Private Owners

To provide training gliders at the earliest possible moment while the production program was getting under way, CTI-651 on 21 May 1942 authorized purchases from private owners. In all, 61 such training gliders of commercial design were purchased from April to August 1942 at a total cost of $86,690.[28]

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27. Ibid., Vol. III, Pt. 1, pp. 175, 185, 191; WS-378, Airc. Acceptances, p. 177; Finance Sec. File of Payments.
28. Table, Gliders Acquired from Civilian Owners, 31 Aug. 1943, prepared by Analysis and Planning Br., SCO, MC, in Control Sec., Proc. Div., WF, ATSC, Model Designation of Army Aircraft, 11th ed., Jan. 1945, p. 61.

Summary

Requirements for training gliders were especially urgent because the training of pilots was essential to the progress of the entire glider program. To meet these requirements the Materiel Center was able to call upon a number of companies with experience in the construction of gliders resembling those needed by the AAF. Even with this advantage, however, the Materiel Center was unable to satisfy the critical demand for training gliders. As a result, AAF engineers turned to the manufacturers of small commercial aircraft. Three companies, Aeronca, Taylorcraft, and Piper, converted their light airplanes into 3-place gliders. These contractors delivered 653 gliders from July 1942 to the end of the year, and supplied 106 more by June 1943.

The conversion project was the outstanding success in the training glider production program, while the contract with the Air Gliders corporation of Barberton, Ohio, was the most striking failure. With political influence evidently brought to bear to continue a fruitless contract, and as an example of the tremendous risk involved in awarding a contract to a "company on paper," the Air Gliders case was a deplorable aspect of glider procurement. The Glider Unit of the Production Division, Wright Field, made repeated attempts to bring about a cancellation of the Air Gliders contract, but was not successful until May 1943, when the contract had progressed far enough to cost the government more than $400,000, or 12 per cent of the total cost of all training gliders produced.

The seven companies given production contracts for training gliders delivered 1,086 articles at a total cost of $3,406,490.46. In addition, 61 gliders were procured from private owners for $86,690, making the total procurement 1,147 and the total cost $3,493,180.46. The first

production model training glider was delivered by Schweizer in February 1942 and the program was completed with deliveries by Schweizer and Air Gliders in July 1943.

The training glider program is summarized in the following table.

PROCUREMENT OF TRAINING GLIDERS*

Contractor	Model	Number on Contract	Number Delivered	Inclusive Delivery Dates	Approximate Unit Cost
Schweizer	TG-2	26	26	Feb. 42-July 42	$ 2,864
Laister-Kauffmann	TG-4A	150	150	July 42-June 43	4,062
Schweizer	TG-3A	110	110	Aug. 42-July 43	4,004
Frankfort	TG-1A	40	40	June 42-Nov. 42	2,775
Aeronca	TG-5	253	253	July 42-Nov. 42**	2,236
Taylorcraft	TG-6	253	253	Aug. 42-Nov. 42	2,596
Piper	TG-8	253	253	Sep. 42-Apr. 43	2,108
Air Gliders	TG-3A	50	1	July 43	415,421
Purchased from private owners			61	Apr. 42-Aug. 42	1,421
		61	61		$3,045 average unit cost
					$3,493,180.46 total cost

* Production contracts listed in order by date of approval.

** One delivered June 1943.

Chapter V

PROCUREMENT OF TACTICAL GLIDERS

Requirements

Following the initiation of preliminary measures in the glider program early in 1941, AAF officials began active consideration of the problems relating to total glider requirements and to tactical use. Extensive conferences were held in Washington and at Wright Field, and in the fall of 1941 Lewin B. Barringer prepared a proposal for the Chief of Staff providing for enough troop-carrying aircraft and gliders for one airborne division by 1 July 1943. In October 1941 the Materiel Division was directed to estimate the effect of contemplated glider procurement on the existing aircraft program.[1] By the following January a definite requirement was taking shape. On 4 February 1942 CTI-480 directed the procurement of 200 to 500 8- or 9-place transport gliders and 500 to 800 15-place gliders. The requirement for 8-place gliders was raised to approximately 3,000 in March in a directive from the Deputy Chief of Air Staff which stipulated that the requirement was to be met by 1 September 1942. On 1 April 1942 General Arnold directed a revision of the requirements to provide also for the procurement of 500 9-place and 3,700 15-place gliders.[2] By this time the Materiel Center had let contracts for 200 8-place and 155 15-place gliders.[3] On

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1. CTI-344, 10 Oct. 1941, and attachment, in ATSC 452.1, Gliders, General, 1941-42; see also Asst. AAG to C/AC, 2 Jan. 1942, in M&S, Airc. Proj. Br. Glider File, 4.110, General.
2. "Resume of AAF Glider Prog.," pp. 2-3, and Exhibit B.
3. Contr. ..535 ac-25851, 26158, 26259, 26257, and 26599.

22 April CTI-558, Addendum No. 1, increased the requirement for 15-place gliders to 4,700.

Early in July the Materiel Center was again reminded of the policy of prosecuting the glider program without interference with existing powered aircraft requirements. CTI-758 directed that the glider production program should be so administered as to comply with the Joint Aircraft Committee's stipulation that it must not interfere with the production of PT-17 (Navy N2S) airplanes for the Navy, Latin America, and the United Kingdom.

On 23 July the Director of Military Requirements announced that A-3 had established a requirement for 3,000 gliders by the end of the year, with "as many more as possible" to be produced by March 1943. The Materiel Command was also advised at that time that "it may become advisable to change gradually from the use of 15-place gliders to the use of 30-place gliders." For that reason the production of 50 30-place gliders originally requested on 5 July "should be expedited."[4]

The establishment of such urgent requirements for gliders at a time when the demand for powered aircraft taxed the skill of both procurement authorities and industry gave the Materiel Center a Herculean task. It was obvious that Wright Field officials were between two fires on the glider program. Sources of production were limited by instructions to avoid interference with the powered aircraft program. But General Arnold was calling for rapid production of gliders. No one was more aware of the plight of the Materiel Center than Brig. Gen. K. B. Wolfe, Chief of the Production Division. Early in July 1942 he told Col. J. W. Sessums,

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4. "Resume of AAF Glider Prog.," p. 3, and Exhibit C.

of the Materiel Command in Washington: "We just can't get everything, so I comply with one order and disregard the others." General Wolfe said he had "personal direct orders from General Arnold" to meet established glider requirements. "I am going to get these gliders if I don't do anything else," he added.[5]

The Materiel Center decided to procure Waco's 8-place CG-3A to meet the requirements for 8- or 9-place gliders, and the same contractor's CG-4A was approved for the 15-place program. In all, 16 companies produced tactical gliders for the AAF. By the first of August 1942, all 16 had been given contracts, and a month later the total procurement on these contracts was 300 CG-3A's and 6,290 CG-4A's.[6] Finding a sufficient number of companies to manufacture that quantity of gliders was a difficult task.

In January 1942 the Experimental Engineering Section at Wright Field, assisted by the Industrial Planning Section, had surveyed approximately 100 companies not then engaged in the manufacture of combat or training aircraft. Colonel Dent and Maj. B. B. Price of the Aircraft Laboratory, with the advice and aid of officials of the Industrial Planning Section, decided that approximately 15 of the companies were capable of participating in the glider production program. Final consideration and negotiations with the prospective manufacturers narrowed the field to 12 companies. These 12 were all given contracts

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5. Phone transcript, Brig. Gen. L. B. Wolfe, Mat.Cent., and Col. J. W. Sessums, MC, Wash., 2 July 1942, in ATSC 452.1, Glider Prog., General, 1942-43.
6. Chart, Production Gliders, appended to this study as App. I. [Cited hereafter as Chart, Prod. Gliders, in App. I.]

before the first of May 1942, and in June and July three more companies, Gibson Refrigeration Company, Ford, and Cessna were added to the list. These 15, together with the design contractor (Waco), were the 16 companies awarded contracts for tactical gliders.[7]

The contracts let in the original production procurement of tactical gliders are listed below. Where the name of a company was later changed as a result of reorganization, or by virtue of being absorbed by another company, the later designation is shown in parentheses.[8]

Contractor	Air Corps Contract No.	Approval Date	Model
Waco Aircraft Company, Troy, Ohio	25851	21 March 1942	CG-3A
General Aircraft Corp., Astoria, N.Y.	26158	26 March 1942	CG-4A
National Aircraft Corp., Elwood, Ind.	26259	27 March 1942	CG-4A
Robertson Aircraft Corp., St. Louis, Mo.	26257	27 March 1942	CG-4A
Laister-Kauffmann Aircraft Corp., St. Louis, Mo.	26599	31 March 1942	CG-4A
Porterfield Aircraft Company, Kansas City, Mo. (Ward Furniture Mfg. Co., Fort Smith, Ark.)	26159	2 April 1942	CG-4A
Jenter Corp., Ridgefield, N.J. (Ridgefield Mfg. Corp.)	26597	3 April 1942	CG-4A
Pratt, Read and Company, Deep River, Conn.	26213	8 April 1942	CG-4A

7. "Glider Report," Vol. I, p. 47.
8. Data compiled from Chart, Prod. Gliders, in App. I; "Glider Report," Vol. IV, passim.

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Contractor	Air Corps Contract No.	Approval Date	Model
Timm Aircraft Company, Los Angeles, Calif.	26232	9 April 1942	CG-4A
AGA Aviation Corp., Willow Grove, Pa. (G & A Aircraft, Inc.)	26255	14 April 1942	CG-4A
Kearwin Aircraft & Engines, Inc., Kansas City, Kans. (Commonwealth Aircraft, Inc.)	26140	23 April 1942	CG-3A
Babcock Aircraft Corp., Deland, Fla.	26256	27 April 1942	CG-4A
Northwestern Aeronautical Corp., Minneapolis, Minn.	26936	27 April 1942	CG-4A
Ford Motor Company, Iron Mountain, Mich.	28380	30 June 1942	CG-4A
Gibson Refrigeration Company, Greenville, Mich.	30115	6 July 1942	CG-4A
Cessna Aircraft Company, Wichita, Kans.	27833	8 July 1942	CG-4A

As the design contractor, Waco was made responsible for supplying data to the other manufacturers of the CG-4A and CG-3A. Kearwin Aircraft (later Commonwealth) was the only company other than Waco to receive a contract for the CG-3A; as a result the function of furnishing design data on this glider was not a major problem. The more extensive CG-4A program involved more complex problems of production. With the exception of Cessna, all manufacturers of the CG-4A signed an "Engineering Assistance and License Agreement" with Waco. By the terms of this agreement Waco furnished all the engineering data and information concerning production methods used by Waco, and the patent and design rights owned by Waco were made available to other contractors for use in

manufacturing CG-4A's. The other CG-4A contractors might also station personnel at the Waco plant to study production methods and secure engineering data, but could not hold Waco liable for any damage or expense incurred as a consequence of such assignment of personnel. To protect Waco against labor pirating, the agreement contained a provision forbidding attempts to induce Waco employees to leave their jobs in order to accept employment with the contractor signing the agreement. For its engineering and production services Waco charged each participating company a fee of $250 per glider on a stated quantity of gliders manufactured by the company. The total number of gliders on which the fee was payable ranged from 20 to 230 and was determined by the size of the contract held by the participating company.[9] These fees, as well as the effectiveness of Waco's performance of functions outlined in the agreements, became one of the much debated issues of the glider program.

Equally difficult was the problem of tooling for CG-4A production. While the original procurement of CG-4A's was under way, the Materiel Center carried on negotiations relating to the establishment of a coordinated tooling program. The Bromley Engineering Company of Detroit received a contract (ac-31360) for the design of tools suitable for the CG-4A program. On 30 July 1942 a cost-plus-a-fixed-fee contract (ac-31761) was given Bromley for the manufacture of master jigs and fixtures to be supplied to the CG-4A contractors.[10] Before that, however, on 1 June the Materiel Center wired the contractors to "start building

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9. "Glider Report," Vol. IV, Pt. 1, p. 187; copy of "Engineering Assistance and License Agreement," Waco and General Aircraft, 19 March 1942, ibid., 188-92.
10. "Glider Report," Vol. I, p. 144.

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CG-4A gliders immediately." The companies were told that they might build their own production tools, jigs, and fixtures, and were advised that interchangeability was "unimportant compared to completing gliders." The companies were further advised that the tooling program with Bromley would "eventually be adopted, but for the next three months it is vitally important to build as many gliders as possible."[11] By the middle of September there was a sharp change in the Materiel Center's view of the tooling program. On 9 September Major Dichman, Glider Project Officer in the Production Division, reported that of the 16 firms in the production glider program, four (Waco, Cessna, Ford, and General) preferred to do their own tooling, and at least six more were under consideration for cancellation of tooling contract. It was not considered worth while to continue the tool design contract for the benefit of some six contractors.[12] By that time it was apparent that the construction of tools by the individual contractors had substantial value as a time-saving expedient. In addition, the tooling procedures of the manufacturers were being coordinated by a committee headed by a member of the Manufacturing Methods Branch at Wright Field. On 12 September the CG-4A contractors were notified that "the proposed government tooling program has been discontinued, and no tools will be available from that source."[13] It was estimated that the Bromley construction contract was

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11. Telg., Lt. Col. E. W. Dichman, Mat. Cent., to 14 CG-4A contractors, 1 June 1942, copy in "AAF Glider Prog., Prod. Proc.," App. J.
12. Memo to Chief, Tr. & Trans. Br., Prod. Div., Mat. Cent., by Maj. E. W. Dichman, 9 Sep. 1942, copy in "AAF Glider Prog., Prod. Proc.," App. J.
13. Chief, Contr. Sec., Mat. Cent., to CG-4A contractors, 12 Sep. 1942, copy in "AAF Glider Prog., Prod. Proc., App. C.

about 40 per cent complete at the time of termination. The canceled tooling program cost the government approximately $647,000.[14]

Later events indicated that the CG-4A contractors were confused and rendered less efficient by the uncertainty surrounding the government tooling program. At least as perplexing was the fluctuation of total requirement figures. As recounted earlier, by August 1942 the Materiel Center had been given a green light on CG-4A production and had responded by awarding contracts to 16 companies, by approving plans for the dissemination of engineering and production data, and by instituting a tooling program. Through the summer of 1942 the contractors assembled personnel, organized production facilities, and purchased materials. The first deliveries of production model tactical gliders were made in September 1942.[15] On 12 September the manufacturers of the CG-4A were sent the following notice:

> The contractor is hereby advised that no further purchase of gliders beyond those called for in the subject contract are contemplated. Notwithstanding this decision, the contractor is urged to pursue a vigorous production schedule in connection with the subject gliders and, at the same time, attempt to secure other business in order that the facilities engaged in the manufacture of gliders may continue to be usefully employed after the completion of the subject contract.
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> It is further requested that the contractor transmit this information to his subcontractors in order that they may also be advised of the situation.[16]

The notice was sent to the contractors by the Materiel Center as a result

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14. TT PROD-T-142, Tech. Exec., Mat. Cent., to C/S, AC, Wash., 24 Aug. 1942, copy in "AAF Glider Prog., Prod. Proc.," App. B; "Glider Report," Vol. I, pp. 144-45.
15. Chart, Prod. Gliders, in App. I.
16. Chief, Contr. Sec., Mat. Cent., to CG-4A contractors, 12 Sep. 1942, copy in "AAF Glider Prog., Prod. Proc.," App. D.

of a decision at Headquarters, AAF. On 7 September the Chief of Staff, Materiel Command, had notified General Wolfe at Wright Field that "Colonel Harper, A-3 of the Air Staff, has just informed this office that no further procurement on the glider program is contemplated except for the tapering off quantity of 250 CG-4A (15 place) gliders which it is understood General Meyers has authorized by telephone."[17]

One week after the contractors were told that there would be no further procurement of gliders, General Meyers gave Col. O. R. Cook at Wright Field the following account of proceedings at Headquarters.

> General Arnold sent me a directive that we build no more gliders. I told him that I wouldn't accept the directive and I went downstairs to a staff meeting and the result of that was that they appointed a board of myself, Tom Hanley, and somebody else to decide what the glider program should be. I'm President of the Board and I'll tell you what it's going to be. We're going to build 350 gliders a month.[18]

On 30 September 1942 the Chief of Air Staff approved the plan to produce 350 gliders per month through 1943.[19] From September through December 1942 the contractors went ahead with production and in that period delivered 773 tactical gliders.[20]

On 5 February 1943 Col. O. P. Weyland, of the Directorate of Air Support in Washington, said that 4,056 gliders would equip the 26 Troop Carrier groups to be activated in the AAF 273 Group Program, and the glider conference at which he made this report decided that the delivery of 6,290 CG-4A gliders by 1 January 1944 would provide at least a

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17. TT E-449, C/S, MC, Wash., to Brig. Gen. K. B. Wolfe, Mat. Cent., 7 Sep. 1942, copy in "AAF Glider Prog., Prod. Proc.," App. D.
18. Phone transcript, Brig. Gen. B. M. Meyers, MC, Wash., and Col. O. R. Cook, WF, 19 Sep. 1942, in AT&C 452.1, Glider Prog., General, 1942-43.
19. "Resume of AAF Glider Prog.," p. 3.
20. Chart, Prod. Gliders, in App. I.

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satisfactory "production nucleus." At that time Operations Division of the War Department General Staff estimated that, because of logistical difficulties which limited the number that could be shipped to war theaters, 6,000 gliders would meet maximum anticipated demands in 1943.[21]

These decisions do not appear to have been transformed into a concise requirement for gliders, however, and in March and April Wright Field officials were attempting to get a definite decision on the type and quantity of gliders desired.[22] There was a note of desperation in the testimony of one Wright Field executive who, lamenting the "absence of a clearly defined policy with regard to future glider procurement," summarized his view of the glider program by observing that "this program started in confusion and will undoubtedly end that way."[23]

From the 14th through the 17th of April a series of meetings was held in Washington to determine requirements and other details of the glider program. On 15 April Brig. Gen. O. A. Anderson, AC/AS, Plans, reported that the War Department General Staff had not completed its requirements for gliders but expected to have them ready soon. General Anderson expressed doubt that gliders could be used in a "major move," and said that "haste should be made slowly in the whole matter."

On 22 April the Operations Division of the General Staff stated that 2,535 gliders were required for all theaters, but failed to take into account attrition and training. As a result of the inadequacy of

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21. "Resume of AAF Glider Prog.," Exhibit F.
22. Phone transcript, Lt. Col. E. W. Dichman and Brig. Gen. K. B. Wolfe, MC, WF, 15 April 1943, in ATSC 452.1, Glider Prog., General, 1942-43.
23. ICM, Actg. Chief, Fisc. Br., to Chief, Proc. Div., Mat. Cent., 29 March 1943, in ATSC Hist. Office. This document, signed by the Acting Chief of the Fiscal Branch, was written by Daniel S. Blackman of that office.

its statement, Operations Division agreed to reconsider the problem. In the meantime the glider conferences held at AAF Headquarters had not been able to arrive at a definite program, and the Materiel Command (established at Wright Field on 6 April) was not given a concise statement of glider aims.[24]

On 15 May Maj. Gen. B. M. Giles, then Acting Chief of Air Staff, gave a blanket answer to the problem by stipulating that "every glider facility now in operation should be continued at maximum production."[25] As of 31 May 1943, glider requirements as summarized by the Special Assistant on the Glider Program called for the production of the maximum number of CG-4A's possible, but not less than 6,290, by 31 December 1943.[26]

The M&D Materiel Division in Washington was not satisfied with the still indefinite requirements, and on 17 June 1943 Brig. Gen. B. M. Chidlaw, its chief, asked General Meyers to get "some sort of an answer" from General Giles. "We have been working constantly (and I do mean constantly) on the Requirements people and on DuPont in an effort to secure the final glider quantity determinations." General Chidlaw referred to "a long series of indeterminate communications" and confessed: "We have about reached the end of our rope here in the Materiel Division."[27] At a conference of 25 June 1943 it was stated that 825

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24. ICM, Asst. Chief, Fisc. Br. to Actg. Chief, Proc. Div., MC, WF, 20 April 1943, in AT3C Hist. Office. Report of Glider Conference, Wash., 15 April 1943; and Report of Glider Conference, Wash., 22 April 1943, copies in "AAF Glider Prog., Prod. Proc.," App. E.
25. Memo for AC/AS, M&D by Maj. Gen. Barney M. Giles, Actg. C/AS, 15 May 1943, copy in "Resume of AAF Glider Prog.," Exhibit K.
26. Memo for AC/AS, M&D by Richard C. duPont, Special Asst., Glider Prog., ibid., Exhibit L.
27. IDM, Gen. Chidlaw to Gen. Meyers, 17 June 1943, in M&S, Airc. Proj. Br. Glider File, 4.1101, Req.

CG-4A's were required to lift one airborne division; on that basis it was agreed that sufficient gliders should be built by July 1944 to provide glider carrying-capacity equal to that of 12,826 CG-4A's.[28] Two months later the Special Assistant for the Glider Program notified the Materiel Division that the War Department General Staff had announced "a material reduction in glider requirements." As a result, there was to be no new procurement and existing procurement was to be completed by 30 August 1944.[29]

While the CG-4A program was being worked out, the Materiel Command went ahead with its development projects for larger gliders. That Washington officials foresaw a requirement for 30-place gliders was indicated in a recapitulation of objectives, in June 1943, by the Office of the Special Assistant on the Glider Program. This report listed as an approved project the development of 30-place gliders and provided specifically that the AAF should "develop and produce" the XCG-13 and the XCG-10.[30]

Schedules for the CG-4A were set up covering production through the first half of 1944, and in September 1943, Brig. Gen. F. M. Hopkins, Jr., of the M&D Resources Division reported that "no additional procurement of gliders is contemplated beyond that which is now scheduled for production before July 1, 1944."[31] However, in October 1943 glider requirements

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28. "Rept. of Conference on Glider Program, 25 June 1943," ibid.
29. ICM, MD, M&D to OC&R, 30 Nov. 1943, ibid.
30. Recapitulation of Glider Development Prog., by Special Asst., Glider Prog., 30 June 1943, ibid., Exhibit N.
31. ICM, Recorder, Aircraft Scheduling Unit, to Chief, Prod. Div., MC, WF, 10 Sep. 1943, copy in "AAF Glider Prog., Prod. Proc.," App. H.

for the fiscal year 1945 were being set up. Maj. Felix duPont of the OC&R Glider Branch estimated requirements for the 1945 program as 1,000 40-place and 800 13-place gliders.[32] In view of Major duPont's expressed interest in the Airborne Transport XCG-16 and of the directive received by the Materiel Command on 1 November to procure 1,000 of these gliders, it seems apparent that Major duPont was thinking of the XCG-16 when he stated the requirement for 40-place gliders. The reference to a 13-place glider posed a problem in view of the fact that the Materiel Command had no aircraft of that specification under development. The question was answered when MM&D learned that the glider referred to by Major du Pont was the 15-place Chase XCG-14. At that date the XCG-14 was in the first stages of development.[33] The Materiel Division, MM&D, referred to the incident as "another example of star gazing by the glider crowd," but believed that since the requirement was to be used only for budget purposes, it might be provided for in the budget estimates without harm.[34]

By the summer of 1944 neither the XCG-16 nor XCG-14 had as yet proved satisfactory as an experimental glider, and the only production procurement was for the CG-4A and the CG-13. Two contracts for the CG-13 were awarded, one in November 1943 for a quantity of 50 to be manufactured by the Northwestern Aeronautical Corporation, and the second

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32. TT AFDMA-4E-144, MM&D, to MC, MF, Attn. Tech. Exec., 29 Oct. 1943, ibid.
33. The XCG-14 contract was not approved until 30 October 1943, and the first article, a static-test model, was not delivered until August 1944, almost a year after Major duPont's statement of a requirement. See p. 34.
34. TT AFDMA-4-210, MM&D to MC, MF, Attn. Tech. Exec., 3 Nov. 1943, copy in "AAF Glider Prog., Prod. Proc.," App. H.

in April 1944 for a like quantity to be constructed by the Ford Motor Company.[35] Supplements to these contracts eventually made the total CG-13A procurement 337. In June 1944, however, the Materiel Command was directed to curtail CG-13A production and, as a result, total procurement of this glider had dropped to 137 by November 1944.[36] As the requirement for gliders of 30-place capacity dropped, there was a renewed drive to obtain the CG-4A and the newly developed CG-15A in larger quantities. By October 1944 requirements for gliders had skyrocketed, and AC/AS, M&S directed an immediate acceleration of the glider program, authorizing specifically the procurement of 4,600 CG-4A and CG-15A gliders.[37] Thus in November 1944 the tactical glider program had survived three years of indecision, often reaching confusion on the basic issue of glider requirements, and had emerged as a vital project demanding the most vigorous prosecution. At that time the total net tactical glider procurement accomplished by the Materiel Command was 100 CG-3A's, 15686 CG-4A's, 775 CG-15A's, and 137 CG-13A's. Of these, 100 CG-3A's, 10,549 CG-4A's, and 47 CG-13A's had been delivered,[38] and the glider manufacturers were under pressure to increase production. Near the end of October the Chief of the Production Section at Wright Field noted the "urgent need for gliders" and defined the glider production objective as the achievement of "a maximum peak delivery rate

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35. Chart, Prod. Gliders, in App. I.
36. ICM, Chief, PES to Chief, Prod. Div., MC, WF, 4 July 1944, in Glider and Misc. Airc. Br., Prod. Sec., WF; Chart, Prod. Gliders, in App. I.
37. ICM, Prod. Div., WF, to AC/AS, M&S, Attn. Brig. Gen. E. H. Powers, 24 Oct. 1944, copy in ATSC Hist. Office.
38. Chart, Prod. Gliders, in App. I.

throughout the year of 1945."[39] This was not the first instance in which Wright Field officials had occasion to speak of an "urgent need" for gliders; but tactical success achieved by gliders had made this probably the first instance in which the "urgent need" was sufficiently definite and persistent to make possible effective long-term planning and full execution of sound plans for glider production.

Contracts and Contractors

Of the 16 companies which manufactured tactical gliders, four (National, Ridgefield, Robertson, and Ward) had no experience in the manufacture of aircraft, and of the remaining 12, only Waco, Ford, Cessna, and possibly Timm could draw upon extensive aeronautical experience in the execution of their glider contracts. Furthermore, only Cessna and Ford had the facilities and the organizational framework expected of a prime contractor attempting the production of aircraft. In brief, it was an unimposing industrial group which undertook the production of the tactical gliders demanded by the AAF.[40] It was not surprising that some of the members faltered and fell by the wayside.

Waco CG-4A. The first production contract for tactical gliders was approved 21 March 1942. This was contract ac-25851 with the Waco Aircraft Company, Troy, Ohio, for 200 CG-3A gliders.[41] Soon after this it was decided that the 9-place CG-3A had little or no cargo-carrying capacity and was generally inferior to the 15-place CG-4A, and no extensive production of the former was contemplated.[42] Accordingly, in

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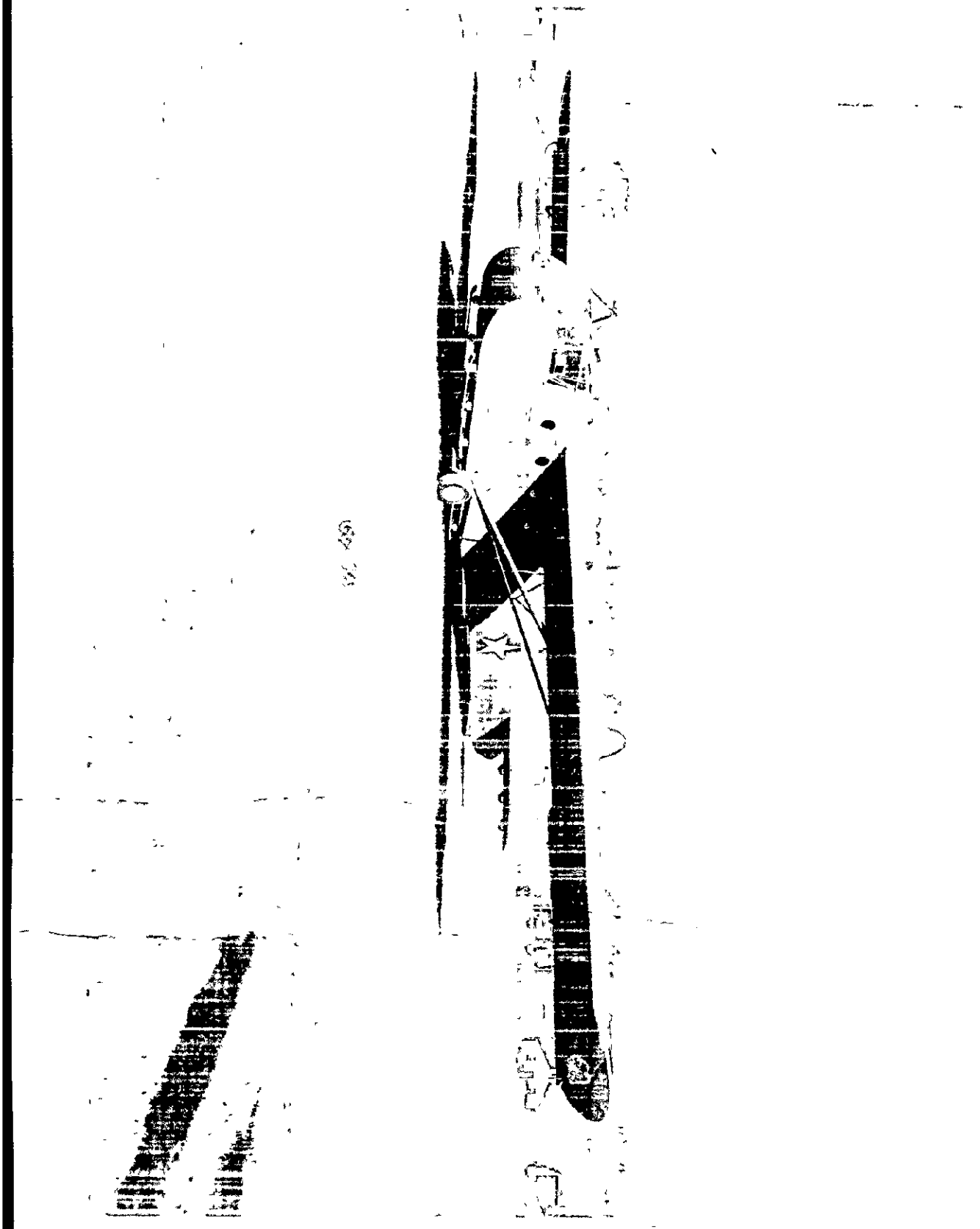
39. ICM, Chief, Prod. Sec., to Chief, Maintenance Div., WF, 24 Oct. 1944, in Glider and Misc. Airc. Br., Prod. Sec., WF.
40. "Glider Report," Vol. V, has a vast array of data on the contractors.
41. Chart, Prod. Gliders, in App. I.
42. "Glider Report," Vol. I, p. 86.



July the 200 CG-3A's with Waco were deleted and a supplement to the contract added 500 CG-4A's. On 14 October 1943 Waco was authorized by Change Order No. 20 to construct an XCG-15 in the place of one of the CG-4A's, and on 27 October a supplement added 500 more CG-4A's. The total procurement on the contract was therefore 999 CG-4A's and 1 XCG-15. On 20 September 1944 a second production contract with Waco was approved. This was contract ac-4160 for 75 CG-4A's, making the total CG-4A procurement with Waco 1,074.

Waco's production record was poor during the first year of the contract. Early in 1943 there was a marked improvement and the company became a steady though not spectacular producer of the CG-4A. Waco's first CG-4A was delivered in October 1942, and contract 25851 was completed in August 1944. The 75 gliders on contract 4160 were delivered in September and October 1944.

Waco's average production in 1943 was about 43 gliders per month; in 1944 it was up to approximately 54. The average cost of the gliders manufactured by this contractor was less than $20,000, an achievement exceeded only by Ford.[43] As the designer of the CG-4A, Waco was in possession of the engineering data from the start and might have been expected to show a better quantity production record. However, the Waco organization was responsible for supplying engineering and production information to the other CG-4A contractors, and in addition was kept busy with experimental work. Waco was a small airplane company before the war, and the accumulation of tasks with which the company was besieged

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43. Chart, Prod. Gliders, in App. I.

after its entry into the glider program taxed the ability of its personnel and the capacity of the facility.[44]

In April 1942, when Waco was laboring to get the CG-4A program under way, Col. F. O. Carroll, Chief of the Experimental Engineering Section at Wright Field, observed sympathetically that "poor old Waco doesn't do anything else but interview visiting firemen who want to build gliders."[45] That Waco also had other problems was made apparent in July when the company notified the Materiel Center that "by reason of the totally unexpected number of Government employees . . . stationed at this plant" the company's furnishings were totally inadequate. Furniture called for under the terms of Defense Plant Corporation Project 398 was not sufficient "to meet the needs of the contractor, the present and anticipated audit personnel, the AAF Resident Representative and his office force, the Inspection force, Property Accountability force, Signal Corps force and others yet to be stationed, housed and supplied with furniture by the contractor." The contractor announced that an application for additional funds on the DPC project would be made to provide the needed equipment.[46]

Other factors affecting or explaining Waco's performance appear in the negotiations by and with other CG-4A contractors.

General CG-4A. Contract ac-26158 for 75 CG-4A's, to be manufactured by the General Aircraft Corporation of Astoria, Long Island, was approved

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44. See "Glider Report," Vol. IV, Pt. 1, pp. 198, 211.
45. Phone transcript, Col. F. O. Carroll, Mat. Cent., and Col. B. W. Chidlaw and Col. J. F. Phillips, WC, Wash., 11 April 1942, in ATSC 452.1, Gliders, Troop Carrying, 1942-43-44.
46. Waco to Mat. Cent., Attn. Airc. Lab., 23 July 1942, in ATSC 452.1, Transport Gliders, 1942-43-44.

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on 26 March 1942. On 10 July the contract was increased by 154 gliders, and in December an additional 284 were specified, making a total of 513 CG-4A's. The contract was completed in December 1943. In the meantime the contractor had been given a second contract (ac-40674) for 500 CG-4A's. This award was approved on 1 September 1943. The first delivery occurred the following month, and in September 1944 the contract was completed. General's unit cost on contract 26158 was approximately $33,770, and although the figure was reduced to about $28,000 on the second contract, neither performance was considered satisfactory in a production assignment calling for a substantial number of gliders.[47]

Like many of the other small, relatively inexperienced concerns brought into the glider program, General Aircraft was not an efficient producer. Early in 1943 the corporation was investigated. The District Inspector General reported on 1 April that the company was poorly managed; that property accountability procedures, inspection functions, and general contract records were below par; and that manufacturing methods at the facility were unsatisfactory. Specifically, it was discovered that stock records and stock on hand did not agree, that receiving reports were inaccurate and improperly executed, that tools and scrap were neither properly identified nor properly stored, that there was no humidity control in the wood-working department, and that both wood inspection and metal inspection were ineffective. Furthermore, the Purchasing Department was so inefficient that purchase orders were being written for items not chargeable to the contract and in some

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47. Chart, Prod. Gliders, in App. I; ICM, Proc. Div., WF to AC/AS, M&S, Attn. Brig. Gen. B. M. Powers, 24 Oct. 1944.

instances the contractor was buying from 15 per cent to 33 1/3 per cent more items than were needed on the entire contract. It was the opinion of the investigating officer that General's purchasing agent knew "very little of purchasing" and that inexperienced subordinates were attempting to do most of the work. And, finally, the president of the corporation, having failed to discover and correct these shortcomings, displayed inadequate executive and administrative ability.

Unfortunately, the way was not clear to correct these conditions, for according to the inspecting officer, the Resident Representative at the plant had "antagonized the whole management." Lt. Col. Al Bodie had been Resident Representative at General on 13 March 1943, and almost immediately uncovered "a number of irregularities" at the plant. He issued directives attempting to correct these deficiencies, but used "no tact or diplomacy," was "very abrupt in his manner and speech," and was "very sarcastic." The inspecting officer believed that there would be no cooperation by the General Aircraft management as long as Colonel Bodie remained at the plant.[48]

Soon after the report of the inspecting officer was submitted, a new Resident Representative was assigned to the General Aircraft plant,[49] and near the end of May 1943 the Materiel Command reported "considerable improvement" in workmanship, production, and management at General.[50] During the remainder of the contractor's work on the CG-4A contracts some of the difficulties, especially those pertaining to inspection,

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48. Dist. Inspector General, EPD to Dist. Supvr., EPD, 1 April 1943, copy in "AAF Glider Prog., Prod. Proc.," App. F.
49. Corres., March-May 1943, Contr. W535 ac-26158.
50. ICM, Chief, Prod. Div. to Chief, Proc. Div., MC, 27 May 1943, ibid.

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persisted. Production was spotty but on the whole satisfactory. The high unit cost of the gliders manufactured by General was a serious matter, and in October 1944 when negotiations were being carried on for accelerated procurement of CG-4A's, General Aircraft was invited to submit a proposal for 100 gliders on a fixed-price basis. The government set $20,000 as a maximum cost per glider, not including export boxing. Having completed its two earlier contracts, General agreed to the government's terms and signed fixed-price contract ac-5910 for 100 CG-4A's.[51]

National CG-4A. On 17 October 1941 National Aircraft was incorporated under the laws of Indiana to manufacture plywood airplane parts. The company had no production record prior to the award of a glider contract early in 1942.[52] Contract ac-26259 for 30 CG-4A's to be manufactured by the corporation at Elwood, Ind., was approved on 27 March 1942. In May 60 gliders were added by a contract supplement.[53]

From the beginning National was an impotent, poorly managed concern. At best, the corporation was able to muster but 130 productive employees and had plant facilities for glider manufacture totaling about 82,000 square feet, including both direct and indirect floor area. As late as October 1942, seven months after the contract was approved, the company had only 87 productive and 105 nonproductive workers;[54] and before that in August, the Production Division at Wright Field notified the Materiel

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51. ICM, Proc. Div., WF to AC/AS, MRS, Attn. Brig. Gen. A. M. Powers, 24 Oct. 1944; Chart, Prod. Gliders, in App. I.
52. "Glider Report," Vol. I, pp. 48-49.
53. Chart, Prod. Gliders, in App. I.
54. "Glider Report," Vol. II, Pt. 1, sec. on National.

Command in Washington that National was "a small concern apparently 'building in a barn'." All indications were that the contractor would be unable to meet his commitments.[55]

On 28 August, Maj. E. W. Dichman, Chief of the Glider Unit in the Production Division, requested the Contract Section at Wright Field to cancel the National Aircraft contract. Major Dichman pointed out that the company was organized by a number of Elwood businessmen, none of whom had any previous experience in the manufacture of aircraft. Managerial problems of the company were severe, and to date the contractor had not demonstrated that he had either the facilities or the funds to manufacture gliders. Action on the recommendation to cancel was deferred, however, when National insisted that a complete reorganization of the company had been effected. In December Wright Field reported that the contractor had not established his production line and Major Dichman again recommended cancellation. On 31 December Wright Field sent National a telegram announcing the government's intention to terminate the contract. This time, however, the Production Engineering Section reversed itself and after an inspection of the plant at Elwood requested the Contract Section to rescind the termination action.[56]

By February 1943 conditions at National were reaching a critical stage. The former owners had sold the company to A. B. Christopher and J. M. Brown, primary stockholders of the Christopher Engineering Company in St. Louis.

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55. ICM, Gen. Wolfe to MC, Wash., Attn. C/S, 22 Aug. 1942, copy in "AAF Glider Prog., Prod. Proc.," App. C.
56. Attachment to ICM, Asst. Chief, Fisc. Br., to Actg. Chief, Proc. Div., MC, WF, 28 April 1943.

The change in ownership was not especially salutary, and by February the situation at National had degenerated to the level of back-yard theatricals. On 8 February the new owners arrived at the plant and gave the general manager 30 seconds to write his resignation. When the request was refused, Christopher and Brown gave the manager his release in writing and ordered the Auxiliary Military Police to eject him from the premises. "In this emergency, the Army Air Forces Representative took over the guard," it was reported. At about the same time, employees at the plant expressed their displeasure over the confusion by stopping work and locking up the first glider in production. At that time the company had no definite production line, and there was only sufficient space to complete one glider at a time in final assembly.[57] The assembly room was on the second floor of the "factory" building and was filled with "a forest of pillars supporting the roof." The room was not wide enough to accommodate the CG-4A wing span "so sides of the building were knocked out and leantos added."[58] A serious fire hazard resulted from a lack of fire doors and proper ventilation and heating facilities in the dope and cover room. Cost and purchasing procedures of the contractor were equally chaotic. There was no general ledger or cost record, and in some instances the purchasing department had issued purchase orders without quantities or prices.[59] When Christopher and Brown were approached concerning corrective measures, "finances were their principal topics of conversation" and they offered no preconceived

57. ICM, Contr. Officer, National Airc. to Dist. Supvr., CPD, 13 Feb. 1943, copy in "AAF Glider Prog., Prod. Proc.," App. M.
58. ICM, Area Supvr., Indianapolis, to Dist. Supvr., CPD, 19 Feb. 1943, ibid.
59. ICM, Contr. Officer to Dist. Supvr., CPD, 13 Feb. 1943.

plan for producing gliders. The Area Supervisor reported that AAF Auditors and the Resident Representative were trying to work out solutions but had to deal with the employees of the company because the management appeared to be "unqualified to steer the boat."[60]

On 26 February 1943 Colonel Richman recommended cancellation, and on 1 March the contract was terminated.[61] In spite of the frantic promises and appeals made by National immediately after the cancellation, the decision to terminate was not rescinded.[62]

National's total production was one CG-4A, which was finally delivered in April 1943. Including an unpaid obligation of some $272,000 as of 31 October 1944, this glider, and the lessons learned during the administration of the contract, cost the government $1,741,808.88.[63]

Robertson CG-4A. The Materiel Command's experience with the Robertson Aircraft Corporation at St. Louis was in many respects a repetition of the struggle with the National Aircraft contract. Robertson's contract ac-26257 for 20 CG-4A's was approved 27 March 1942. Supplements to the contract in June 1942 and August 1943 increased the total quantity on contract to 170 gliders.

The Robertson orporation had engaged in aircraft service and training activities before the war.[64] Major Barringer thought the corporation was

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60. ICM, Area Supvr., Indianapolis, to Dist. Supvr., CPD, 19 Feb. 1943.
61. ICM, PDS to Chief, Proc. Div., Mat. Cont., Attn. Capt. L. S. Robinson, 26 Feb. 1943, copy in "AAF Glider Prog., Prod. Proc.," App. M; Attachment to ICM, Asst. Chief, Fisc. Br. to Actg. Chief, Proc. Div., MC, WF, 28 April 1943.
62. Attachment to ICM, Asst. Chief, Fisc. Br. to Actg. Chief, Proc. Div., MC, WF, 28 April 1943.
63. Chart, Prod. Gliders, in App. I.
64. "Glider Report," Vol. II, Pt. 2, sec. on Robertson.

a well-staffed, vigorous organization, and even the critical eye of Major Dichman saw a definite "sincerity of purpose" in the Robertson group. Major Dichman, however, anticipated a delay in the completion of the first glider.[65]

By December Robertson had not delivered a single glider and there was increasing evidence that all was not well at the contractor's plant. The administrative officer for the Resident Representative reported serious "errors and delays" at the factory and bluntly accused "Major" William B. Robertson, president, of "gross mismanagement." The Robertson organization was "so torn with jealousies" and "hampered by restrictions and lack of authority that it is disgraceful." Although this company was "large enough to handle efficiently a contract ten times as large as the one they are working on," the report declared, the high proportion of incompetent men in positions of authority crippled the organization.[66]

As early as August 1942 Major Dichman had expressed a desire to cancel or at least divert materials from the Robertson contract.[67] In view of the adverse reports on the contractor in December, the Production Division took a more definite stand and again recommended cancellation of the contract. On 31 December 1942 Robertson was notified that the contract was being canceled. Appeals of the contractor for a chance to continue finally resulted in a recision of the termination notice, and early in March 1943 Robertson informed Colonel Dichman that the company

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65. Attachment to ICM, Asst. Chief, Fisc. Br. to Actg. Chief, Proc. Div., MC, WF, 28 April 1943.
66. Ibid.
67. Memo for Chief, Tr. & Trans. Br. by Maj. E. M. Dichman, 24 Aug. 1942.
68. Attachment to ICM, Asst. Chief, Fisc. Br. to Actg. Chief, Proc. Div., MC, WF, 28 April 1943.

would like to be given any unfinished glider contracts available.[68] By 17 March only six gliders manufactured by Robertson had been accepted, as against a scheduled requirement of 23 gliders due by the first of that month. On 20 March the Production Division again recommended cancellation.[69]

In April General Meyers, Deputy AC/AS, M&D, submitted data on the glider manufacturers to Lt. Gen. William S. Knudsen, Director of Production in the Under Secretary's office, and requested a decision on the desirability of canceling the contracts of marginal or high-cost producers. General Knudsen recommended that the contracts of Robertson and three other contractors be canceled. However, on 1 May Under Secretary of War Robert P. Patterson notified General Meyers that he believed it would be cheaper to continue all CG-4A contracts than to cancel those of the poor producers.[70] Robertson was allowed to continue production of the CG-4A, and by August the company had delivered 63 gliders.[71]

On 1 August 1943 a Robertson-built CG-4A, the sixty-fifth manufactured by the corporation, crashed on a demonstration flight at Lambert Field, St. Louis, when a wing disintegrated in flight. All of the

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68. Attachment to ICL, Asst. Chief, Fisc. Br. to Actg. Chief, Proc. Div., MC, WF, 23 April 1943.
69. ICL, Chief, Prod. Div., Mat. Cent. to MC, Wash., Attn. AC/AS (P), 20 March 1943, copy in "AAF Glider Prog., Prod. Proc.," App. G.
70. Memo for US/W, by Brig. Gen. B. E. Meyers, Dep. AC/AS, M&D, 17 April 1943; memo for US/W by Lt. Gen. William S. Knudsen, Dir. of Prod., 17 April 1943; and memo for Brig. Gen. B. E. Meyers, by US/W, 1 May 1943, copies in "AAF Glider Prog., Prod. Proc.," App. F.
71. Chart, Prod. Gliders, in App. I.

passengers were killed, including company executives, St. Louis city officials, and AAF officers.[72] The incident catapulted Robertson Aircraft and the glider program in general into national prominence, and the AAF rushed its investigations of the crash. The complex system of subcontracting, involving several degrees of subassembly at various factories and a complicated flow of materials from contractors to subcontractors and back, made the problem of establishing responsibility for the tragedy exceedingly difficult. Investigation finally revealed that the crash was caused by the failure of an end inner wing fitting manufactured by the Gardner Metal Products Company in St. Louis, former manufacturers of caskets. Charles C. Letty, inspector in charge, and William A. Williams, receiving inspector at Robertson, were suspended but were held not responsible by the Midwestern Procurement District Board of Officers investigating the crash. The men were reinstated by instructions from Headquarters, Materiel Command, on condition that they not work in the St. Louis area; they refused to leave St. Louis and resigned their positions. While not holding the two inspectors responsible for passing defective equipment, the investigating board reported that inspection personnel in general at Robertson were inexperienced and had

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72. The tragedy cost the lives of ten men: William B. Robertson, president, and Harold H. Krenger, vice president and production manager, Robertson Aircraft; William D. Becker, Mayor, Charles L. Cunningham, Deputy Comptroller, and Max H. Doyne, Director of Public Welfare, City of St. Louis; Thomas K. Dysart, president of St. Louis Chamber of Commerce; Henry L. Mueller, judge, St. Louis County Court; Lt. Col. Paul H. Hazelton, AAF Resident Representative, St. Louis Area Office; and Capt. Milton C. Hugh, pilot, and Pfc. J. W. Davis, co-pilot and mechanic, I Troop Carrier Command.

inadequate inspection equipment.[73] Furthermore, Col. L. M. Johnson of the Inspector General's Department reported that his investigation of the Robertson crash left him "firmly convinced that the conditions which were in existence at St. Louis prior to this accident are prevalent throughout the country. There is little that the Materiel Command can do to correct conditions."[74] Poor workmanship, improper methods of manufacture, and general inefficiency at the plants of contractors were all unfortunate aspects of the glider program. Colonel Johnson said the inspection set-up of the Materiel Command was "certainly not sufficiently manned or experienced to cope with the situation." Although Maj. Gen. C. E. Branshaw, Commanding General, was attempting to build up his inspection force, he was handicapped by manpower limitations.[75]

The entire affair was in a sense unfortunate for the Robertson corporation as well as for the glider program in general. Columnist Drew Pearson, for example, made the incident the basis of an inflammatory attack and complained that "the entire U.S. glider program has been woefully neglected."[76] There is no reason to doubt that such an accusation was accepted at face value by thousands of readers not in possession of the facts that prove the fallacy of such a sweeping indictment. As for the company, the tragedy of the incident and the commotion resulting

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73. Inspection Div. Rept. on Crash of CG-4A Glider in St. Louis on 1 Aug. 1943, attachment to ICM, Chief, Insp. Div., to CG, MC, WF, 13 Aug. 1943; ICM, Asst. Tech. Exec., to DC/S, MC, WF, 25 Aug. 1943; and TT HQT-57, Inspector General, MC, WF, to AC/AS, MMD, 14 Oct. 1943, all filed in AFSC 452.1, Robertson Glider Crash.
74. Col. L. M. Johnson to the Air Inspector, Wash., 9 Sep. 1943, in AAG 452.1D, Gliders.
75. Ibid.
76. Minneapolis Star Journal, 10 Aug. 1943.

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from subsequent investigations inevitably upset the entire organization. Moreover, the discovery of inadequate inspection methods and the spur to more effective performance which might have been expected to result from the incident did not noticeably increase Robertson's production ability. In fact, in March 1944, 95 gliders manufactured by Commonwealth, Waco, and Robertson were grounded pending investigation of improper material control and the use of unauthorized materials at Anheuser-Busch, subcontractor making fuselage frames, and at Robertson Aircraft.[77] And in spite of the fact that the AAF implied confidence in the company by allowing a contract supplement for an additional 100 gliders to be processed and approved a month after the crash at Lambert Field, deliveries on the Robertson contract averaged less than six gliders a month in the period September 1943 to November 1944. As of 31 October 1944, 23 of the 170 gliders on the contract had not been delivered,[78] and the Glider Branch of the Procurement Division at Wright Field reported that Robertson had "a poor production record, and poor inspection record and high costs." The unit cost of the gliders manufactured by Robertson was approximately $28,000, according to a report of the Contract Audit Section based on 70 gliders.[79] As of 31 October, however, records of the Finance Section at Wright Field showed total payments of approximately $5,700,000 (not including advance payments) on the Robertson contract. At that time the contractor had delivered 147 gliders. On this basis Robertson's unit cost was about $39,000.[80]

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77. Rept. of Conference on CG-4A Gliders--Defective Material and Parts, 20 March 1944, in Glider and Misc. Airc. Br., AF.
78. Chart, Prod. Gliders, in App. I.
79. Proc. Div., AF to AC/AS, M&S, Attn. Brig. Gen. E. M. Powers, 24 Oct. 1944.
80. Finance Sec. File of Payments; Chart, Prod. Gliders, in App. I.

In October 1944 Robertson was given a fixed-price contract for 100 CG-4A's to be built at a maximum price of $20,000 each, not including export boxing.[81] There was little in the contractor's past performance to indicate that the company could produce gliders for that price or in sufficient numbers to be of any substantial help in the glider program. It appeared that this contractor was getting by on good intentions.[82]

Laister-Kauffmann CG-4A. The Laister-Kauffmann Aircraft Corporation was another of the small corporations enlisted in the glider program. A contract (ac-26599) with this company was approved on 31 March 1942. The original contract quantity of 30 CG-4A's was increased by 80 gliders in June 1942, and in December 1943 the addition of 100 made the total quantity on contract 210. After a shaky start, the contractor rallied to become a steady, though slow, producer. The first glider was not delivered until January 1943, and only two had been delivered by April of that year. From that time on, however, Laister-Kauffmann was able to deliver approximately 12 gliders a month and the contract was completed in August 1944. The unit cost of the Laister-Kauffmann gliders was about $29,000.[83]

Financial difficulties of this contractor nearly resulted in cancellation of the contract during the first year of the company's participation in the CG-4A program. In January 1943 the situation was so bad that Laister-Kauffmann appeared unable to continue without

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81. Proc. Div., WF to AC/AS, M&S, Attn. Brig. Gen. L. M. Powers, 24 Oct. 1944.
82. See ibid., p. 6: "the management has been most cooperative in endeavoring to correct their various difficulties."
83. Chart, Prod. Gliders, in App. I.

substantial financial assistance by the government, and the Area Auditor at St. Louis reported that improper financing had caused so large a labor turnover that the plant was "nothing more than a training school." Several recommendations that the contract be canceled were made by District and Wright Field officials, but no final action was taken, and in May 1943 the Under Secretary of War gave Laister-Kauffmann a new lease by deciding that it would be cheaper to continue the contract than to cancel.[84] The final accounting on the CG-4A contract shows that the contractor's production record was good considering the size of the corporation and the other development and production projects it had undertaken.[85] While working on CG-4A production, the company developed the XTG-4, completed two production contracts for the TG-4A, and developed the XCG-10A.

After completing the contract for 210 CG-4A's, Laister-Kauffmann accepted a fixed-price contract for 100 of the same model gliders. This contract (ac-5911) was approved on 24 October 1944.[86]

Ward CG-4A. Contract ac-26159 for 20 CG-4A's was assigned to the Porterfield Aircraft Company of Kansas City, Mo., and approved on 2 April 1942. Preliminary negotiations were carried on with E. E. Porterfield, Jr., and the original award was in fact made to Porterfield as an individual. The company was incorporated after a contract had been agreed upon. Although several employees of the company had previously been engaged in the manufacture of aircraft, the contractor had

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84. Attachment to ICM, Asst. Chief, Fisc. Br. to Actg. Chief, Proc. Div., MC, WF, 28 April 1943; memo for Brig. Gen. B. E. Meyers, by US/A, 1 May 1943.
85. See Proc. Div., WF to AC/AS, M&S, Attn. Brig. Gen. E. M. Powers, 24 Oct. 1944.
86. Chart, Prod. Gliders, in App. I.

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made little progress on the contract when the capital stock of the Porterfield company was purchased by the Ward Furniture Manufacturing Company of Fort Smith, Ark., in May 1942. Porterfield's facilities were moved to the Ward plant in June, and in October the Porterfield Aircraft Company was dissolved and Ward assumed full responsibility for the glider contract.[87]

In the summer of 1942 Procurement District officials were told that Ward was not making substantial progress on the contract, and the District Production Engineering Office suggested that the contractor revamp his organization and prepare to engage solely in glider production. District officials reported that Ward had followed this suggestion and said the company was "in a position to be a very important factor in the glider project if given only an ordinary amount of future assistance." From October 1942 to March 1943 the contractor experienced serious difficulty in getting into full production and was guilty of faulty workmanship. Ward's costs mounted rapidly, and in March the Aircraft Procurement Branch at Wright Field recommended cancellation of the contract. Colonel Dichman concurred in the recommendation, and on 1 April the Ward contract was terminated.[88]

With a supplementary quantity of 30 gliders added in June 1942, the contract called for a total of 50 CG-4A's. Of these, seven were delivered. As of 31 October 1944 payments totaling $2,335,990.38 had been made on the contract and the government owed Ward an additional

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87. Ibid.; "Glider Report," Vol. II, sec. on Ward.
88. Attachment to IC[illegible], Asst. Chief, Fisc. Br. to Actg. Chief, Proc. Div., MC, WF, 28 April 1943; IC[illegible], Chief, Prod. Div. to Chief, Proc. Div., MC, WF, 12 Jan. 1944, in Glider and Misc. Airc. Br., Prod. Sec., WF.

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sum of $320,209.76. On this basis the gliders purchased from Ward cost the government approximately $380,000 each.[89]

Ridgefield CG-4A. A contract for 20 CG-4A's was placed with the Jenter Corporation of Ridgefield, N. J. This contract (ac-26597) was approved on 3 April 1942, and the following month the total quantity was increased to 55 CG-4A's and an XFG-2 powered glider (described earlier in this study). In October 1943 the contractor accepted a supplement providing for an additional 100 CG-4A's.[90] In the meantime, in April 1943 the contractor was renamed the Ridgefield Manufacturing Corporation.[91]

Before the war the company had accumulated extensive experience in the manufacture of exhibits and displays involving the use of wood, metal, plastics, and fabrics. As a result Ridgefield had a working knowledge of many of the processes used in glider manufacture in spite of the fact that the company had no actual experience in the production of aircraft.

Ridgefield was, however, a small concern, employing in 1943 about 250 productive laborers and 130 nonproductive workers on glider manufacture,[92] and the contract for 155 CG-4A's was too small to allow economical construction. In addition, the contractor insisted that conditions over which he had no control interfered with his production. The necessity of securing materials without interfering with the bomber

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89. Chart, Prod. Gliders, in App. I.
90. Ibid.
91. "Glider Report," Vol. I, p. 50.
92. Ibid., Vol. II, sec. on Ridgefield.

and fighter plane programs and the loss of trained personnel to the armed forces were cited as serious impediments. Furthermore, the contractor claimed that Waco had promised to complete delivery of drawings, bills of material, and working instructions by about 1 May 1942 but did not actually complete these deliveries until September.[93] The experience of other contractors indicates that there was a great deal of validity in Ridgefield's view of its problems. The unit cost of the Ridgefield gliders was about $8,000. The first article was delivered in January 1943 and the contract was completed in July 1944.[94]

In October 1944 Wright Field reported that Ridgefield was building CG-4A and CG-15A tail surfaces as a subcontractor to Waco, and stated that attempts would be made to induce other prime contractors to purchase tail surfaces from this subcontractor. Although Ridgefield's record in CG-4A production was considered good for a small contractor, the corporation was well occupied with subcontracting glider and other work and did not desire to continue as a prime contractor in the glider program.[95]

Pratt, Read CG-4A. Pratt, Read and Company, Inc., of Deep River, Conn., was a well established firm with experience in precision woodwork and the manufacture of machined parts. In July 1941 the company began the development of a training glider subsequently produced for the Navy; and when the Pratt, Read contract (ac-26213) for 75 CG-4A's was approved on 8 April 1942 the company had a staff technically skilled and

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93. Ibid.; Rept. on Prod. of CG-4A Glider, as of Feb. 27, 1943, by Jenter Corp., in Corres., Contr. W535 ac-26597.
94. Chart, Prod. Gliders, in App. I.
95. Proc. Div., AF, to AC/AS, M&S, Attn. Brig. Gen. E. E. Powers, 24 Oct. 1944.

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experienced in aeronautical engineering and manufacturing.[96] In May 1942 the Pratt, Read contract was increased to 575 gliders, and in October 1943 an additional quantity raised the total on contract to 925.[97]

Like most of the other CG-4A contractors, Pratt, Read submitted production schedules which could not be met. On 30 March 1942 the contractor notified the Materiel Center that he could produce 247 CG-4A's by the end of the year and 877 by July 1943, provided that plans, specifications, and materials could be obtained as needed.[98] Delivery statistics indicate that the contractor was wise in attaching conditions to the proposal. Only one CG-4A was delivered in 1942, and the 877th glider was not delivered until June 1944, a year after the date mentioned in the original estimate made by the contractor. Nevertheless, Pratt, Read was able to deliver gliders at a rate satisfactory to the AAF after early production delays had been overcome. Unfortunately, the unit cost of Pratt, Read gliders was higher than most, averaging about $30,000 per glider. The contract for 925 CG-4A's was completed in June 1944, and in October the contractor was offered a fixed-price contract for 100 more. Pratt, Read turned down this proposal on the grounds that the quantity of gliders offered was too low, the company having been able to deliver approximately 60 gliders per month starting in June 1943. Wright Field officials were of the opinion that Pratt, Read should not be given a cost-plus contract in the procurement arranged to meet requirements of

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96. "Glider Report," Vol. II, sec. on Pratt, Read; Chart, Prod. Gliders, in App. I.
97. Chart, Prod. Gliders, in App. I.
98. Gould Aero. Div. of Pratt, Read to Mat. Cent., Attn. Lt. Col. Fred R. Dent, 30 March 1942, in MTSC 452.1, Pratt, Read and Co., Inc.

the extended glider program as it existed in October 1944. However, they added that "further expansion of the glider program beyond that presently established will require the services of Pratt, Read even though their unit cost may be higher than the average."[99]

Timm CG-4A. The Timm Aircraft Company of Los Angeles was given a contract for 230 CG-4A's, later increased to 971. The original contract (ac-26232) was approved 9 April 1942; the supplement adding 741 gliders was approved in June.

Timm got into production on the contract somewhat sooner than the majority of the CG-4A manufacturers and delivered the first glider in October. However, the contractor did not achieve a satisfactory rate of production until the summer of 1943.[100]

In October 1943 Col. Donald Stace, Supervisor of the Western Procurement District, requested cancellation of the Timm contract at the 402d article in order that the facilities and manpower of the contractor and his subcontractors might be used to increase P-38 production. Los Angeles was at that time considered a highly critical labor area, and the government had directed a reduction in the work carried on in such designated areas. As a result of these considerations the Materiel Command terminated the Timm contract at the 402d article and promptly ran into trouble.[101] The Weber Showcase and Fixture Company in Los Angeles, a subcontractor to Timm, wanted to know what they could do with 100 completed wing kits

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99. Proc. Div., AF to AC/AS, M&S, Attn. Brig. Gen. E. M. Powers, 24 Oct. 1944; Chart, Prod. Gliders, in App. I.
100. Chart, Prod. Gliders, in App. I; TT PES-4533, MC, AF to Dist. Supvr., Western Proc. Dist., 16 Oct. 1943, copy in "AAF Glider Prog., Prod. Proc.," App. M.
101. MC, AF to CG, AAF, Attn. AC/AS, M&D, Lt. Col. L. T. Bradbury, 27 Oct. 1943; TT PES-4579, MC, AF to Supvr., WPD, 30 Oct. 1943, ibid.

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ready for final assembly and asked permission to continue the assembly of wings for use as spares. Some five other subcontractors had similar problems which were carried to Wright Field officials, and the Assistant Regional Director of the United Aircraft Workers Union asked Colonel Dichman to continue Timm's glider contract.[102] On 30 October the Materiel Command wired the Supervisor of Western Procurement District requesting a reconsideration of the situation and a recommendation of a cut-off point which would permit the termination to be accomplished without all the confusion it was causing. The Materiel Command, the wire said, had been "deluged by long distance telephone calls and teletypes from officials of labor unions and subcontractors' representatives, protesting against the cancellation of the Timm contract."[103] The seriousness of the situation was indicated in a communication from M&D in which the Materiel Command was urged to watch the cancellation carefully and to handle the matter "with kid gloves." Recalling the unfavorable view of cancellations taken by the Under Secretary of War in May 1943, M&D advised caution lest the Materiel Command "find themselves right smack dab in the middle once again." M&D agreed, however, that the acceleration of the P-38 program was more important than building CG-4A's at that time.[104]

Two days later M&D officials had ample justification for their circumspection in the matter. On 4 November General Chidlaw told Col. Cook and

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102. Telg. (undated), Weber Showcase and Fixture Co. to Lt. Col. E. M. Dichman, MF; Telg. Asst. Regional Dir., United Aircraft Workers, CIO to Lt. Col. E. M. Dichman, and Harlow Airc. Co., to Supvr., MPD, 1 Nov. 1943, ibid.
103. TT PES-4579, MC, MF to Supvr., MFD, 30 Oct. 1943.
104. TT AFDMA-1-283, AC/AS, M&D to MC, MF, Attn. Col. C. L. Cook and Lt. Col. L. M. Dichman, 2 Nov. 1943, copy in "AAF Glider Proc., Prod. Proc.," App. A.

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Colonel Lichman:

> What I feared has come to pass, since we have already received a telephone call from Senator Downey of California advising that he had just received a long telegram from Los Angeles stating . . . that the termination of the Timm CG-4A glider contract was releasing some four thousand . . . skilled workers who will have difficulty in finding new employment in their profession.

Senator Downey wanted to know how these people would be employed.[105]

In the meantime the Western Procurement District had taken steps to utilize the plants of Timm's subcontractors in work for Lockheed and Douglas. Timm facilities and personnel were being reorganized and arrangements were planned whereby Timm would become a subcontractor to several of the major West Coast aircraft manufacturers. If a satisfactory solution could not be arranged in the entire matter, workers affected by the Timm cancellation could be absorbed under the jurisdiction of the War Manpower Commission. While these negotiations for future employment were being carried on, companies affected by the cancellation were being assisted in their attempts to hold plant personnel. The Contracting Officer at Timm was carrying out a program calling for the completion of certain units "in the interest of the government." These facts were relayed to M&D by the Materiel Command with a citation of War Department Procurement Regulations,[106] pertaining to labor supply policy, basis for termination, and factors governing revision of supply contracts. The Materiel Command found in these regulations authority for canceling the contract of a contractor behind schedule in production and located in a

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105. TT AFDMA-1-285, AC/AS, M&D to MC, WF, Attn. Col. Cook and Lt. Col. E. W. Dichman, 4 Nov. 1943, ibid.
106. Procurement Regulations No. 2, 15 Oct. 1943, pars. 223.3 and 223.4, and No. 15, 14 Aug. 1943, pars. 15-101, 15-102, and 15-103.

critical labor area where the demands of more vital production programs deserved precedence. It was believed that the cited Procurement Regulations superseded the view of cancellations expressed earlier in 1943 by the Under Secretary of War.[107]

In order to ease the problems of the companies affected by the termination, the effective cancellation date was moved up to 6 December 1943,[108] allowing more time for rearrangement of contractual and facility relationships. There was no further extension of the Timm contract, and all deliveries accomplished on the contract were completed in December 1943. For the 433 CG-4A's delivered, Timm was paid $19,636,284.12, not including unrecouped advance payments as of 31 October 1944. With an unpaid obligation of $2,519,797.30 due the company on that date, the unit cost of the Timm gliders was a little more than $51,000.[109]

G & A CG-4A. A contract (ac-26255) for 60 CG-4A's was awarded to the AGA Aviation Corporation of Willow Grove, Pa., and was approved on 14 April 1942.[110] The name of the corporation was changed in August to G & A Aircraft, Inc., and in May 1943 the capital stock of the corporation was purchased by the Firestone Tire and Rubber Company. The company had its origin in the Pitcairn Autogiro Company, which had antecedents going back to the early 1920's.[111]

G & A did not become a major producer of the CG-4A, but the contractor's

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107. Actg. Supvr., WPD to MC, WF, Attn. PES, 2 Nov. 1943; TT PES-4596, DC/S, MC, WF to AC/AS, MM&D, Attn. Prod. Br., 4 Nov. 1943, ibid.
108. IOM, Chief, Prod. Div. to Chief, Proc. Div., MC, WF, 12 Jan. 1944, in Glider and Misc. Airc. Br., Prod. Sec., WF.
109. Chart, Prod. Gliders, in App. I.
110. Ibid.
111. "Glider Report," Vol. II, sec. on G & A.

unit cost of approximately $25,000 represented one of the best performances in the glider program; and G & A production, variable as it was, supplied a substantial number of gliders.[112] The contractor claimed that the drafting of personnel into the armed forces, and the consequent problems of training replacements, caused "considerable difficulty" and, in fact, reduced operating efficiency.[113]

The first delivery of a G & A production glider occurred in December 1942, and by November 1944 the contractor had delivered a total of 464 CG-4A's. Supplements to the contract in 1942 and 1943 added 412 gliders to the original quantity, and in October 1944 a letter contract for 459 raised the total procurement from G & A to 922, of which 458 were still to be delivered.[114]

Commonwealth CG-3A and CG-4A. Contract ac-26140 for 100 CG-3A 8-place gliders to be manufactured by Rearwin Aircraft and Engines, Inc., Kansas City, Kans., was approved on 23 April 1942. The total on contract was increased to 300 by Supplement No. 2 to the contract on 3 July; but dissatisfaction with the CG-3A as a tactical glider led to a decision to concentrate on the more suitable CG-4A, and in November the contract was reduced to call for the original quantity of 100 CG-3A's. Deliveries on the CG-3A contract were completed in May 1943.[115]

Supplement No. 2 to the Rearwin contract provided for the manufacture

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112. Chart, Prod. Gliders, in App. I.
113. G & A Airc., Inc. to Area Contr. Officer, Philadelphia, 28 Oct. 1943, in Control Sec., Proc. Div., WF.
114. Chart, Prod. Gliders, in App. I; Proc. Div., WF to AC/AS, M&S, Attn. Brig. Gen. E. M. Powers, 24 Oct. 1944.
115. Chart, Prod. Gliders, in App. I; Dept. on Rearwin Airc. Co., 12 Jan. 1943, by Lt. Col. E. W. Dichman, copy in "AAF Glider Prog., Prod. Proc.," App. M.

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of 300 CG-4A's in addition to the 200 CG-3A's added. When the 200 CG-3A's were canceled in November, the CG-4A quantity was increased to 450. In August 1943, 500 more CG-4A's were procured on Supplement No. 12.

Following reports that the contractor was not making satisfactory progress on the glider contract, Major Barringer, glider program coordinator, inspected the Rearwin facility in July and reported a serious lack of organization and morale. He found that R. A. Rearwin, Sr., president of the corporation, was difficult to work with and displayed little executive ability. On 10 July the Rearwin company notified Wright Field that Waco was not supplying necessary engineering data, and a few weeks later Colonel Dichman observed that the CG-3A priority rating was so low that Rearwin was having difficulty building gliders.[116] In spite of these excuses, however, it was not believed that the contractor was making any sincere attempt to remedy his own shortcomings, and on 22 August the Production Division, Wright Field, recommended cancellation of the contract.[117]

Early in October Rearwin Aircraft was purchased by a group of bankers of New York and Fort Smith, Ark., and R. A. Rearwin, Sr., and his sons, Robert and Kenneth Rearwin, resigned as directors and officers of the company but remained in the employ of their successors. In January 1943 the name of the corporation was changed to Commonwealth Aircraft, Inc.[118]

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116. Rept. on Rearwin Airc., 12 Jan. 1943, by Lt. Col. E. W. Dichman; Chronological Arrangement of Data Regarding Cancellation, Commonwealth Airc., in "AAF Glider Prog., Prod. Proc.," App. M.
117. ICM, Chief, Prod. Div., Mat. Cent. to MC, Wash., Attn. C/S, 22 Aug. 1942.
118. Rept. on Rearwin Airc., 12 Jan. 1943, by Lt. Col. E. W. Dichman; Chronological Arrangement of Data Regarding Cancellation, Commonwealth Airc., in "AAF Glider Prog., Prod. Proc.," App. M.

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By March 1943 three CG-3A's had been delivered and one CG-4A had been accepted but not delivered. On 20 March Wright Field again recommended cancellation, but as in the case of other contractors the opposition of the Under Secretary of War prevented the immediate accomplishment of termination.[119]

In contrast to the costly retention of Babcock,[120] Robertson, and Timm, the prolongation of the Commonwealth contract proved to have fortunate results. In March the contractor delivered 39 gliders, in April 48, in May 32, and in June the CG-3A's had been completed and Commonwealth delivered 30 CG-4A's. Production rose to a high of 122 deliveries in September 1943, and from that time until the completion of the contract in July 1944 the contractor delivered an average of approximately 65 gliders per month. Not only did Commonwealth become one of the best producers of the CG-4A, but the unit cost of the CG-3A's and CG-4A's manufactured by that corporation was approximately $24,200. Although the 8-place CG-3A might be expected to cost less than the larger CG-4A, the Commonwealth unit cost, computed from deliveries and payments on their combined production, represents an accomplishment at least the equal of that of the majority of other successful producers of tactical gliders.[121] It is, in fact, not unreasonable to assume that administrative work, tool and jib adjustment and conversion, and other

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119. ICD, Chief, Prod. Div., Mat. Cent., to MC, Wash., Attn. A/CS (P), 20 March 1943; memo for Brig. Gen. B. E. Meyers by US/M, 1 May 1943.
120. See pp. 117-20.
121. Chart, Prod. Gliders, in App. I.

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adaptations made necessary by the change from CG-3A to CG-4A production fully offset any cost advantage gained in the construction of the smaller glider.

In October 1944 Wright Field reported that Commonwealth's administrative problems had been corrected, and although the contractor's facility was labeled "fair," the company's production and inspection record had proved "good."[122] A cost-plus-a-fixed-fee contract (ac-5887) for an additional 660 CG-4A's to be supplied by Commonwealth was approved on 19 October 1944.[123]

Babcock CG-4A. The Babcock Aircraft Corporation was organized at Deland, Fla., in May 1939 to produce light-weight commercial airplanes. Restrictions imposed by the National Defense Program on commercial production led to the abandonment of the company's plans in 1941 before production was under way on the Babcock airplane. Babcock thereupon applied for defense work.[124]

In February 1942 the company received a Letter of Intent authorizing the manufacture of CG-4A gliders, and a formal contract ac-26256 for 50 CG-4A's was approved on 27 April 1942. The next month a supplement to the contract added 102 gliders.[125]

The contractor's preparations for handling the glider contract were not auspicious. Personnel still associated with Babcock early in 1942 were not sufficient to produce the gliders, and additional workers whose only experience had been in the Florida citrus groves were recruited.

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122. Proc. Div., WF to AC/AS, M&S, Attn. Brig. Gen. C. M. Powers, 24 Oct. 1944.
123. Chart, Prod. Gliders, in App. I.
124. "Glider Report," Vol. II, sec. on Babcock; Hist. of the Babcock Airc. Corp., prepared by Hist. Sec., SEPD, 1944, pp. 1-2.
125. Hist. of Babcock Airc. Corp., p. 2; Chart, Prod. Gliders, in App. I.

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The former Babcock plant was also inadequate, and to meet the increased production load the contractor leased the Volusia County Fairground and Buildings for $1.00 per year. The corporation was totally without funds, and advance payments of 30 per cent on the contract were secured and used for alteration of the rundown buildings leased at the fairground and for the purchase, rental, and installation of equipment.[126] By February 1943 the buildings used by Babcock were crowded to capacity. At this point the contractor rented a large circus tent which was erected at Deland for glider assembly. When the tent was destroyed by a windstorm in July, the renting agency sued Babcock for $10,000 on technicalities relating to insurance and the dismantling of the tent. To add to the trials of the contractor and the government, the fairground buildings used by Babcock were woefully unsatisfactory as facilities. Rain fell through large holes in the roofs and walls, and humidity and temperature control was almost nonexistent. One of the most significant lessons of the Babcock venture was the discovery that the high humidity prevalent in Florida made gluing operations in glider manufacture difficult and faulty. In one series of destruction tests samples of fabricated parts showed 95 per cent glue failure.[127]

Further to complicate the Babcock production effort, the contractor's welding processes, salvage policies, and financial position were all unsatisfactory. And as if to insure inadequate accomplishment, the whole

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126. Hist. of Babcock Airc. Corp., pp. 3-4. Expenditure of advance payment sums for buildings or building repairs was not provided for in the contract and became a point of contention in later negotiations. Ibid., p. 4, and Exhibit II.
127. Ibid., pp. 18, 37-40.

unsavory picture was topped by a bitter feud between Babcock and AAF personnel. The AAF Inspector in Charge and the Resident Representative were the chief targets for the contractor's barbs, and in return, these and other AAF officials did not look kindly upon either the corporation's intentions or its ability and frequently said so. The disputes finally reached a point where the contractor openly labeled the inspector a "vicious and incompetent man" and in a sworn statement accused the Resident Representative of deliberately obstructing the company's operations by action and loose talk, the latter best illustrated by a reference to a company invoice as a "whore's dream." This episode followed by a few days a dispute which led the Resident Representative to seal and station guards at the Babcock warehouses containing AAF equipment.[128]

Babcock also insisted that factors other than the interference and incompetence of AAF personnel prevented effective glider production. Aaco's engineering service was neither prompt nor accurate; the failure of the government tooling program delayed production; low priorities on materials caused further delays; and the red tape, the questionnaires, and the "continued stream of...visitors from the AAF" bearing revised regulations all resulted in confusion and misspent effort on the part of the contractor.[129] The frequency with which these and similar charges were made by other contractors suggests the validity of Babcock's complaints. Equally significant, however, is the observation that other contractors facing the same problems were able to produce gliders in satisfactory quantities and at reasonable prices.

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128. Ibid., pp. 8-9, 18, 19-20, 31, Exhibits IV, XVIII, XXIII.
129. Ibid., Exhibit I.

On 24 June 1943 the quantity of gliders on the Babcock contract was reduced to 60 in a "partial termination."[130]

Fifty-four of these gliders were delivered from April to August 1943, and the remaining six were destroyed by a hurricane but were credited to the contractor and shown in Materiel Command records as delivered in December.[131] AFSC records as of 31 October 1944 showed that Babcock had been paid $3,063,292.93 on contract 26256 and that the contractor owed the government $8,913.77. The unit cost of the CG-4A's built by Babcock was nearly $51,000.[132]

By the time the Babcock contract was finally canceled in March 1944,[133] it was obvious that the corporation should not have been given a contract in the first place, and once awarded, the contract should not have been allowed to run for more than a year before termination proceedings were effective. It is questionable whether even the demand for gliders combined with the elimination of major aircraft companies as sources justified the award of a contract to a company with almost no facilities, inadequate personnel, and no experience in production. Even in gambles on glider production, at a time when rapid production is essential and cost is considered secondary, the odds against success may often be too great to warrant a venture.

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130. Ibid., Exhibit X.
131. Chart, Prod. Gliders, in App. I; "Glider Report," Vol. III, Pt. 1, p. 139. The complex and discordant negotiations relating to the financial settlement of the Babcock contract, as well as the general history of the corporation, have been detailed in an official AAF monograph. Hist. of Babcock Airc. Corp., previously cited.
132. Chart, Prod. Gliders, in App. I.
133. Ibid.

Northwestern CG-4A. The Northwestern Aeronautical Corporation of Minneapolis was incorporated on 27 February 1942 to produce gliders for the AAF. The corporation acquired the physical assets of the Columbia Aircraft Corporation of Kansas City, Mo. Before the war Columbia had manufactured several types of small commercial airplanes used extensively in the civilian pilot training program. When this program was terminated early in 1942, Columbia closed its plant.

All stock of the Northwestern Corporation was owned by Auchincloss, Parker, and Redpath, Inc., investment bankers of New York. During the formation of the company, Northwestern entered into a contract with Northwest Airlines, Inc., whereby that corporation agreed to furnish engineering, production, and financial counsel.[134]

Northwestern's original contract (ac-26936) was for 30 CG-4A's and was approved on 27 April 1942. In May 54 gliders were added and in December the total procurement was raised to 299 CG-4A's. By the summer of 1943 Northwestern's production was better than 50 CG-4A's per month, and in May and June the Materiel Command procured 600 more gliders on contract 26936, making a total of 899.[135]

By its performance on the glider contract Northwestern proved that a small concern could, with intelligent management, reasonable facilities, and sound financial backing, become a highly satisfactory producing agency. John E. Parker, a partner in the stockholding investment firm, became president of the corporation, and a staff of promising men was assembled to hold the key executive positions in the company. The contract with

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134. "Glider Report," Vol. II, sec. on Northwestern.
135. Chart, Prod. Gliders, in App. I.

Northwest Airlines was a sagacious move to insure competent engineering and other technical advice, and the contractor began operations with a solid financial structure. An experienced independent accounting firm was hired to set up an accounting system, and skilled engineers to form the nucleus of a capable working force were supplied by Northwest Airlines. By August 1943 the corporation employed 1,048 workers and had plant facilities totaling 75,000 square feet.[136] In all of these provisions for efficient operation the blessing of competent executive direction is evident. Such pointed and thorough preparations for production can be achieved only by alert and vigorous management.

Northwestern was not only able to produce CG-4A's at a substantial rate but also gave highly valuable assistance to its subcontractors. The DePonti Aviation Company, manufacturers of fuselage frames, and the Villaume Box and Lumber Company, manufacturers of wings, floors, and tail surfaces, achieved excellent production results as subcontractors largely as a consequence of the competent assistance and guidance of the prime contractor. These subcontractors were so effective, in fact, that early in 1943 an Inspector General's report of a special inspection of Northwestern complained that they were producing subassemblies in excess of the requirements of the prime contractor. It was recommended that "immediate steps be taken to control the output of these subcontractors." More in harmony with the spirit of the glider program, the Production Engineering Section at Wright Field replied that "if subcontractors are doing their part so well that they are crowding a prime contractor, the remedy lies in speeding up the prime contractor's assembly process rather

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136. "Glider Report," Vol. II, sec. on Northwestern.

than in holding back the subcontractor. In this case, acceleration is being effected by the Northwestern Aeronautical Corporation."[137]

Northwestern made the first delivery on the CG-4A contract in October 1942. In December a second glider was delivered, and in January 1943 the contractor delivered 23 CG-4A's. In 1943 Northwestern delivered an average of a little better than 46 CG-4A's per month, and for the first half of 1944 deliveries averaged 54 per month. In July two gliders were delivered, but the 12 remaining on contract, although completed, were not delivered because of storm damage. These gliders completing the existing procurement were subsequently delivered, and the contractor may rightly be credited with completion of the contract for 899 CG-4A's in July 1944. The CG-4A's built by Northwestern in 1943 and 1944 were constructed for approximately $24,500 each; this was an accomplishment exceeded only by Ford and Waco and matched by Commonwealth.[138] It is, of course, true that Northwestern had an advantage over some producers which had higher unit costs--the advantage accruing from production of larger quantities.

When procurement was made for the extended glider program in October 1944, Northwestern was called upon for the second largest number of CG-4A's purchased. In August Northwestern had been given a contract (ac-4159) for 200 CG-4A's and 115 CG-15A's. In October this procurement

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137. ICM, Inspector, Mat. Cent. to Prod. Div., Mat. Cent., 8 Feb. 1943, and 1st ind., PLS, Mat. Cent. to Asst. Inspector General, AF, 15 Feb. 1943, copies in "AAF Glider Prog., Prod. Proc.," App. M.
138. Chart, Prod. Gliders, in App. I. The account of the late delivery of Northwestern's last 12 gliders was told to the writer on 2 February 1944 during preparation of this monograph.

was canceled and replaced by a supplement to the original contract. The number of gliders purchased was left at 315, but all were to be CG-4A's,[139] the decision having been made to confine CG-15A procurement to Waco.[140] Later in October a letter contract for 860 CG-4A's was issued to Northwestern, bringing the total new procurement from that company to 1,175 gliders.

Ford CG-4A. On 16 March 1942 five representatives of the Ford Motor Company conferred with representatives of the Aircraft Laboratory to discuss the possibility of Ford's participation in the glider program.[141] Subsequent negotiations resulted in the award of a contract (ac-23330) for 1,000 CG-4A's, approved on 30 June 1942.[142]

In view of the resources, facilities, and experience of the Ford Motor Company, it is interesting to note that Ford had delivered only six gliders by February 1943. While this accomplishment was not by any means unsatisfactory for a company that was not brought into the program until some three months after the majority of companies had been given contracts, nonetheless it indicates that the problems of getting into full production were not resolved in a matter of a few weeks. In fact, serious delays in getting under way were common to all of the glider manufacturers with the exception of Cessna, and, as will be seen later, Cessna received extensive government aid not given to other contractors. The experience of the Ford Company viewed in relation to the performance of other contractors suggests that agencies responsible for glider

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139. Chart, Prod. Gliders, in App. I.
140. Proc. Div., WF to AC/AS, M&S, Attn. Brig. Gen. E. M. Powers, 24 Oct. 1944.
141. Mat. Cent. Memo Rept. EXP-M-51/AD-1038, 20 March 1942, in ATSC 452.1, Ford Motor Co.
142. Chart, Prod. Gliders, in App. I.

procurement are bound to allow at least six months for getting into quantity production after the award of contracts. Without a well-organized tooling program and ready access to materials, this preparatory or preliminary organization period might be greatly extended.

If the Ford performance demonstrated the unavoidable requirement of several months for preparations for production, it also proved the advantage of placing procurement with experienced, financially sound concerns familiar with technique of quantity production. The Ford glider plant at Iron Mountain, Mich., produced more than twice the number of gliders manufactured by any other company in 1942, 1943, and 1944.[143] It is true, of course, that Ford production was not handicapped by concomitant work on experimental glider projects, but even this factor in no way minimizes this contractor's contribution to the glider program.

In March 1944 Wright Field procured an additional 1,200 CG-4A's from Ford, and in September the contract was further increased by 725 gliders. As a part of the October 1944 procurement for an extended CG-4A program, Ford was awarded a letter contract for an additional quantity of 2,000, making a total procurement of 4,925 CG-4A's from this contractor. As of 31 October 1944 Ford had delivered 2,418 CG-4A's and 26 CG-13A's,[144] or 23 per cent of the tactical gliders supplied by the entire glider program. Ford's unit cost of approximately $15,400 on these gliders proved the economy of efficient, experienced mass production.[145]

Gibson CG-44. Of the concerns enlisted in the glider program, the Gibson Refrigerator Company of Greenville, Mich., demonstrated the most

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143. Ibid.
144. See App. I.
145. Chart, Prod. Gliders, in App. I.

successful conversion to glider production of a plant which had not previously produced aircraft. Gibson was, in fact, one of the best producers of the entire program. The Gibson Company was incorporated in 1908 and until 1942 was engaged in the manufacture of electric refrigerators and ranges. Following the suspension of peacetime production Gibson undertook several fixed-price contracts for the Army Ordnance Department, the Army Air Forces, and the Navy.[146] Preliminary negotiations with the company early in 1942 finally resulted in cost-plus-a-fixed-fee contract ac-30115 for 423 CG-4A's, approved on 6 July.[147]

On 29 August 1942 Colonel Dichman reported that Gibson's progress was "quite disappointing." The company's jigs were not very far along, he said; the shop was "very dirty" and things were "piled about in considerable confusion," and the contractor, anxious to get into production on other war goods, was not giving sufficient attention to the CG-4A work. Colonel Dichman admitted the validity of Gibson's claim that material shortages and failure to the government tooling program had delayed them, but found so much evidence of laxity at the plant that he suggested cancellation of the glider contract unless there was "a marked improvement" within the next month. A conference was held with Gibson executives to analyze the contractor's problems and find solutions.[148]

By February 1943 Gibson had drawn abreast of the majority of the CG-4A contractors, and from that time until the completion of the contract in July 1944 Gibson delivered an average of 62 CG-4A's per month. The 1,055 gliders produced on this contract included the original 423 and

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146. "Glider Report," Vol. II, sec. on Gibson.
147. Ibid.; Chart, Prod. Gliders, in App. I.
148. Report of Lt. Col. E. W. Dichman, 29 Aug. 1942, in "AAF Glider Prog., Prod. Proc.," App. M.

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a supplementary quantity of 632 added in November 1943. Gibson's unit price of a little under $26,000 was well below the average in the glider program.[149]

In October 1944 the Glider Branch, Procurement Division, at Wright Field pronounced the Gibson record good in all particulars, including production, cost, and inspection. However, Gibson did not desire to participate in the extended CG-4A program. The company preferred to avoid long-term commitments because Gibson officials hoped to resume the manufacture of refrigerators "in the near future." In addition the company was engaged in manufacturing fuel tanks, bomb shackles, and parts subcontracted on the B-24 program for Ford. Gibson expressed a willingness to accept a new glider contract, however, in case the requirements for gliders were greatly increased and the Procurement Division needed the company's services.[150]

Cessna CG-4A. Early in March 1942, when it appeared that requirements for gliders for that year would far exceed production unless drastic steps were taken, the AAF violated the policy of avoiding the established aircraft companies in glider procurement and turned to the Cessna Aircraft Company at Wichita. Cessna was asked to prepare facilities for the production of 200 CG-4A's per month; and with the understanding that an original order for 1,000 gliders would be placed, Cessna began the

149. Chart, Prod. Gliders, in App. I.
150. Proc. Div., AF to AC/AS, M&S, Attn. Brig. Gen. E. M. Powers, 24 Oct. 1944. (After the research for this study was completed it appeared that vanishing thoughts of reconversion and increased glider requirements had combined to bring Gibson back into the glider program. The company was given a contract for 500 CG-4A's. See EC-1005, Corrections to Working Schedule W-13, 31 Jan. 1945, in AFSC Hist. Office.)

construction of a subsidiary plant at Hutchinson, Kans. When the Materiel Center indicated in June that 1,500 CG-4A's were desired by October, arrangements were made for Cessna to subcontract a large share of the work to two other major aircraft manufacturers -- Boeing and Beech. The Wichita Division of Boeing Aircraft was enlisted to manufacture fuselage frames and to assemble outer wing panels and flyaways, and the Beech Aircraft Corporation was to make tail groups and assemble inner wing panels. Cessna was given a letter contract in June, and a fixed-price contract ac-27833 for 1,500 CG-4A's was approved on 8 July 1942.[151]

From the beginning every effort was made to provide Cessna supplies and conditions favorable to rapid production. On 6 June 1942 the Joint Aircraft Committee approved a proposal to place 1,500 gliders in Group I of the Aircraft Preference List, and the Materiel Command in Washington stood ready to process special requests for AA priorities "for limited quantities of materials and services through the Army-Navy Munitions Board."[152] For its part, the ANMB assigned an AA-1 preference rating to the Cessna contract on condition that the AAF eliminate from other contracts an amount of material equal to that added in the Cessna project by virtue of the AA-1 rating. The Materiel Center notified the Materiel Command that 500 of the Cessna gliders were being produced without the aid of this AA-1 rating, and to comply with the Board's stipulation on materials,

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151. "Glider Report," Vol. III, Pt. 1, p. 11; Chart, Prod. Glider, in App. I.
152. TT C-286, AM&D to Brig. Gen. K. B. Wolfe, Mat. Cent., 6 June 1942, in ATSC 452.1, Glider Prog., General, 1942-43.

147 B-24's were to be taken from the AA-1 list to match the 1,000 CG-4A's added. This would not affect B-24 production, the Production Division said, because a reduction of more than 147 B-24's was already provided in a revised schedule for that airplane.[153]

As might have been expected, the matter of getting materials for Cessna was not handled as definitely and simply as the preference assignments tend to indicate. On 6 July the Industrial Planning Section at Wright Field said that "Cessna is to receive priority in delivery of material over all other Army aircraft orders."[154] But the regulations and official pronouncements merely afforded a basis for action; when these failed to insure necessary supplies, Brig. Gen. K. B. Wolfe stepped in to direct the campaign personally. The bitter competition for materials was clearly displayed in the struggle to get the Cessna gliders built. General Wolfe said that the Navy had induced the War Production Board to issue illegal AA priorities by taking advantage of a current dispute over the authority of the WPB, "Summerville" (probably Lt. Gen. Brehon B. Somervell, Commanding General of the Army Service Forces), and the Munitions Board in the assignment of priorities. The Navy, he said, had "jumped the gun" to get these priorities while the rating system was being changed, and was taking material before the AAF could act. With this in mind, General Wolfe pushed through the assignment of illegal priorities

153. TT E-539, Exec., MC, Wash., to Tech. Exec., Mat. Cent., 28 July 1942; and TT PROD-T-397, Prod. Div., Mat. Cent. to C/S, MC, Wash., 7 Aug. 1942, copies in "AAF Glider Prog., Prod. Proc.," App. B.

154. IOM, Col. P. Schneeberger, Chief, Industrial Planning Sec., to Chief, Prod. Div., Mat. Cent., 6 July 1942, in ATSC 452.1, Glider Prog., General, 1942-43.

to get welding equipment for Cessna. That he himself was experienced in this procedure was suggested by his observation that the WPB had issued the illegal priorities to the Navy "the same as they did for us on...Boeing and Consolidated."[155]

General Wolfe had good reason for taking drastic action. On 18 July, for example, he confessed that a lack of generators at Cessna had created a serious problem: "we are more or less desperate because we have got 400 men sitting there looking at the walls." In this emergency he directed an official of the Central Procurement District to get five generators to Cessna by any means possible.[156] Such aggressive tactics paid dividends, for the supplies problem persisted through the entire Cessna project,[157] and if unresolved, might easily have wrecked the whole plan.

Cessna delivered 32 gliders in September 1942 and 223 the following month.[158] While the first deliveries on the contract were being made, it was decided to release the facilities of this contractor for full-time work on powered aircraft. A Change Order dated 31 October reduced the quantity on contract to 750 and Cessna was given an opportunity to revise its price quotation on the fixed-price contract for 750 CG-4A's. By the terms of the original contract for 1,500 gliders, the excessive costs resulting from the accelerated production requested by the AAF would have been distributed over the entire contract. Government

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155. Phone transcript, Brig. Gen. B. E. Meyers, MC, Wash., and Brig. Gen. K. B. Wolfe, Mat. Cent., 18 July 1942, in ATSC 452.1, Cessna Airc. Co.
156. Phone transcript, Maj. Armitage, CPD, and Brig. Gen. K. B. Wolfe, Mat. Cent., 18 July 1942, in ATSC 452.1, Cessna Airc. Co.
157. See, for example, the story of a vacillating priorities policy in TT PE-141, AC/S (P), MC, Wash., to Prod. Div., Mat. Cent., 10 Sept. 1942, copy in "AAF Glider Prog., Prod. Proc.," App. D.
158. Chart, Prod. Gliders, in App. I.

acceptance of Cessna's revised quotation of $22,742,625 for 750 CG-4A's enabled the contractor to amortize these costs over the reduced quantity of gliders.[159]

In November Cessna delivered the amazing total of 407 CG-4A's, and in December 85 more were delivered, leaving three to be delivered, in January 1943, to complete the contract.[160] For 255 flyaway gliders with tactical and training gear Cessna received $31,000 each, and for 495 gliders with tactical gear only and crated for export, $29,975 each, making the average unit cost of the 750 Cessna-built CG-4A's $30,324.[161]

There is no doubt that the Cessna manufacturing project was the most striking example of accelerated production in the glider program. Unfortunately acceleration was not the only outcome. In May 1943 the Production Engineering Section at Wright Field pointed out that the Cessna gliders "were built under the stress of a highly accelerated program which required deviations from standard procedure," and as a result the "quality of workmanship is poor and many details are not in accordance with Army Air Forces standards."[162] Further evidence that the Materiel Center consciously allowed a sacrifice of quality to achieve rapid production is contained in a Contract Section letter relating to the Cessna cutback. On 12 November 1942, the Contract Section wrote Cessna that the reduction in contract ac-27833 "from 1500 gliders to 750 gliders without spares is not occasioned by any default or inability of

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159. "Glider Report," Vol. I, p. 88; Chart, Prod. Gliders, in App. I; Cessna Airc. Co. to Contr. Sec., Mat. Cent., 23 Sep. 1942, copy in "AAF Glider Prog., Prod. Proc.," App. M; Finance Sec. File of Payments.
160. Chart, Prod. Gliders, in App. I.
161. Ibid.; Cessna to Contr. Sec., Mat. Cent., 23 Sep. 1942.
162. IOM, Chief, PES to Chief, Prod. Div., MC, WF, 11 May 1943, in ATSC 452.1, Glider Prog., General, 1942-43.

the Cessna Aircraft Company to meet the terms and requirements of the contract."[163] This statement, when read with the Materiel Center's admission of poor workmanship on Cessna gliders, is in effect a strong suggestion that the "requirements of the contract" were not very high with respect to quality. It is also significant that the cutback of the Cessna contract involved cancellation of spares. The Maintenance Division of the Air Service Command notified the Materiel Center in February 1943 that parts manufactured by different glider contractors were not interchangeable and that Cessna gliders could not be repaired by using parts of different make.[164] Cancellation of the Cessna spares was therefore certain to make more difficult the repair of an already inferior glider.

Maintenance and other field experiences with the Cessna CG-4A's left little doubt that the gliders were poorly constructed. During a glider modification project at Elyria, Ohio, in November and December 1942, it was found that Cessna gliders at that station were not properly equipped with empennage brace wire fittings. A rush call for 400 fittings brought a prompt shipment from Cessna, but the fittings arrived without bushings, and a second request for equipment became necessary.[165] Cessna gliders used in the training program and especially in maneuvers early in 1943

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163. Chief, Contr. Sec., Mat. Cent. to Cessna, 12 Nov. 1942, in Folder 9-1: Interchangeability, Trainer & Cargo Br., Maint. Div., WF.
164. Lt. Col. John A. Ball, Asst., Maint. Div., ASC to CG, Mat. Cent., 18 Feb. 1943, ibid.
165. Notes on Glider Modification Program at Elyria, Ohio, Nov-Dec. 1942, by Rolland F. Fetters, in Folder 9-3: Mod. at Elyria, Trainer & Cargo Br., Maint. Div., WF.

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were severely assailed, as shown in the following extract from a telephone conversation between Major Coate of Maxton Army Air Base, N. C., and Lt. Rolland F. Fetters of Headquarters, Air Service Command, 21 April 1943:

Fetters: Major Coate, do you know that 75 more CG-4A cased Cessna gliders are to be shipped to your depot for erection and placed in immediate service?
Coate: Oh, no! Please don't send any more of those gliders.
Fetters: Why not, sir?
Coate: Our first maneuvers have just been completed and we have 170 gliders in our shop now for Technical Order compliances, and some of them are lulus. On top of that, we just had another little windstorm like the first one we had.
Fetters: How many gliders did you lose this time, sir?
Coate: Only 26.
Fetters: Were any of those Cessnas?
Coate: No, dammit. Most of them were brand new.[166]

In July 1943 at a glider discussion by maintenance and base personnel at the Laurinburg-Maxton Army Air Base it was decided that the Cessna glider, which had "been found to be a poorer grade and less durable," would be used at that base "for training purposes etc."[167]

In all of these criticisms of the Cessna gliders, the Materiel Center was in an unenviable position. While the poorly made Cessna gliders were causing headaches in the training program, information reached the Materiel Center that General Arnold believed the CG-4A was too thoroughly engineered and too expensive, and that construction of the glider required too much time.[168] The widely held view of the glider as a vehicle designed for a single tactical mission was in conflict with the demands

166. Phone transcript, Maj. Coate, Maxton Army Air Base, N. C., and Lt. Rolland F. Fetters, Hq. ASC, 21 April 1943, in Folder 9-11; Erection Project, Maxton, N. C., Trainer & Cargo Br., Maint. Div., WF.
167. Rept. on Meeting 7-10-43 at Laurinburg-Maxton Army Air Base, N. C., 12 July 1943, ibid.
168. ICM, Asst. Chief, Fisc. Br. to Actg. Chief, Proc. Div., MC, 20 April 1943.

of a training program, which required that gliders be flown repeatedly and as long as they were serviceable. Proper training and the successful conduct of maneuvers made it necessary to use the same model glider being produced for combat use, so that the only solution fully to satisfy both interests—tactical and training—was to build two versions of the CG-4A, one more durable for training, the other highly expendable for tactical purposes. With Washington officials exerting strong pressure to insure rapid development and production of gliders, even that one solution was not feasible. The problem was to a large degree solved later in the glider program: pick-up devices and other salvage operations and principles were developed; the basic design of the CG-4A was found suitable for continued development; the CG-4A was successfully used in tactical operations; and increasing interest in provisions for the safety and comfort of glider crews and passengers insured a well-engineered glider. All of these factors contributed to a gradual acceptance of the view that the tactical glider should be a durable and efficient vehicle capable of performing repeated missions.

While the change in the conception of the glider as a tactical weapon eliminated a dilemma for the Materiel Command, nothing in the original or succeeding concepts fully explains or justifies the low quality of the Cessna CG-4A's. Although the "one mission" concept might have given the Materiel Center justification for allowing the construction of an inferior glider at Cessna, the argument seems never to have been seriously advanced at Wright Field. The truth was that the Materiel Center and the Waco Aircraft Company had developed a rather well-engineered and complex glider and expected to produce it. The break with the "expendable" or

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"one mission" view had therefore occurred in the development project and not in production techniques or standards. When Cessna was still getting production facilities organized, the Materiel Command knew that the urgent requirements of the training program would be met before other demands.[169] Consequently the Materiel Center had, if anything, an incentive to build a quality glider capable of numerous missions. That Cessna did not build a high-quality glider may be attributed primarily to five factors: (1) the Materiel Center, faced with the stiffest possible production deadlines, granted deviations from standards to save time; (2) the CG-4A was still an experimental glider when Cessna began to produce it in quantity, and there was no production experience upon which the contractor might rely; (3) the priorities and materials problems faced by Cessna, even with government aid, were sufficient to reduce the contractor's performance; (4) in the absence of a master tooling program Cessna hastily provided jigs, fixtures, and other items which were not always satisfactory;[170] and (5) from the beginning Cessna glider production was a high pressure project and workers engaged in production and tooling on the Cessna gliders were certain to feel a greater responsibility for speed than for quality workmanship.[171]

Certainly the Cessna Aircraft Company cannot be held responsible for the trials and difficulties involved in the production, use, and maintenance of the Cessna CG-4A's. The Materiel Command wanted gliders on a schedule apparently impossible to attain; the Materiel Center instituted a program to build the gliders and authorized deviations and other aids to rapid

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169. Glider Pilot Training Program, pp. 34-35.
170. See statement by Maj. Gen. O. P. Echols in "Glider Report," Vol. I, p. 139.
171. Ibid.

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production; and Cessna built the gliders on those terms, not in number sufficient to meet the demands of Washington officials, but faster than any other contractor has produced CG-4A's. That the gliders manufactured by Cessna were inferior is well known. Likewise, it is generally admitted that extensive routing of materials to Cessna was done at the expense of other CG-4A contractors and interfered with their production. It is also true that the disposition of surplus materials left as the result of the cutback on the Cessna contract involved some of the most confusing and complicated proceedings in the entire glider program and resulted in the shipment of inferior and useless supplies to other CG-4A contractors. And it is known that the government paid for much useless material on the cost-plus-a-fixed-fee contracts held by companies which received Cessna's surplus goods.[172] Finally, in addition to the adverse procurement factors, maintenance of the Cessna gliders was made exceedingly difficult by a lack of spares and by the inferiority of the gliders.

It is true that the Cessna project gave the training program a quantity of gliders when they were urgently needed. But this advantage does not prevail when weighed in the balance against the price paid for Cessna's accelerated production.

Northwestern CG-15A and Waco CG-15A. Following the development of the CG-15A by Waco in 1944, two production contracts were let for this glider. Contract ac-4159 with the Northwestern Aeronautical Corporation was approved on 1 August 1944. In addition to the CG-4A's called for, as noted earlier, this contract provided for the manufacture of 115 CG-15A's. Before Northwestern could get into production on the new model,

172. A detailed account of the disposition of Cessna's surplus materials is contained in "Glider Report," Vol. IV, Pt. 1, pp. 239-72. An exact financial accounting of losses in this affair is and will probably always be almost impossible.

however, the heavy demand for CG-4A's in the extended glider program for 1945 dictated a cancellation of the commitment for the CG-15A's. In October 1944 contract ac-4159 was canceled and replaced by a supplement to Northwestern's CG-4A contract.[173]

Waco's contract ac-4160, approved on 20 September 1944, provided for the manufacture of 75 CG-4A's and 385 CG-15A's. The CG-4A's called for were delivered in September and October, leaving the contract effective for and limiting Waco's production to CG-15A's only. Because the CG-15A incorporated many features different from those of the CG-4A and since the new model glider had not yet been used in service, procurement officials decided in October to limit production of the CG-15A to the engineering contractor. It was believed possible that future service experience with the new glider might make it desirable to change some CG-4A contracts to CG-15A procurement.

In October 1944 a directive from AC/AS, M&S calling for an acceleration of the glider program resulted in the procurement of an additional 390 CG-15A's from Waco, raising to 775 the total on contract. There were no deliveries on the contract as of 31 October 1944. The estimated unit cost of the CG-15A crated for export was $20,547.99.[174]

Northwestern CG-13A and Ford CG-13A. On 9 June 1943 CTI-1358 directed the procurement of 50 YCG-13's from Ford and 50 from Northwestern, and specified that Waco, the design contractor, should supply the engineering data and drawings for the manufacture of this new 30-place glider.[175]

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173. Chart, Prod. Gliders, in App. I; Proc. Div., WF to AC/AS, M&S, Attn. Brig. Gen. E. M. Powers, 24 Oct. 1944.
174. Contr. W33-038 ac-4160; Chart, Prod. Gliders, in App. I; Proc. Div., WF to AC/AS, M&S, Attn. Brig. Gen. E. M. Powers, 24 Oct. 1944.
175. CTI-1358, 9 June 1943, copy in "AAF Glider Prog., Prod. Proc.," App. O.

Contract ac-40642 for 50 YCG-13's with Northwestern was approved 19 November 1943. This procurement was later revised to call for 1 YCG-13, 2 YCG-13A's, and 47 CG-13A's. In June 1944 the total procurement was increased by 200 CG-13A's, but this quantity was canceled in November leaving the original contract for 50 gliders. As of 31 October 1944, Northwestern had delivered 21 of this quantity at a unit cost of approximately $195,000.[176]

When Ford was approached early in 1943 concerning the production of "a larger glider," Charles E. Sorensen, vice president of the Ford Motor Company, replied that "the company is not in a position to take on any more work of any kind at the present time." An expanded B-24 program and work on Pratt and Whitney engines, he said, would occupy Ford's "full capacity in every direction."[177] Negotiations were continued, however, and Ford finally reversed the earlier decision and agreed to accept a contract for CG-13's. Procurement was effected by a supplement to the company's contract for CG-4A's. Although this supplement for 50 YCG-13's was not finally approved until 3 April 1944, Ford delivered one YCG-13 in January 1944 and one YCG-13A in April. Forty-eight of the gliders on contract were changed to CG-13A's, and 37 CG-13A's were added by a later supplement. Of the total procurement of 87 gliders of this model, Ford had delivered 26 by 31 October 1944, making a total of 47

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176. Chart, Prod. Gliders, in App. I. The high cost of getting into production on a new model renders this unit cost quotation inaccurate as an estimate of actual quantity production costs.
177. Charles E. Sorensen, vice pres., Ford Motor Co., to Maj. Bruce B. Price, Asst. Chief, Glider Br., Eng. Div., Mat. Cent., 2 April 1943, in AT3C 452.1, Ford Motor Co.

CG-13's delivered by both CG-13 contractors.[178]

At the time of the acceleration of the glider program in October 1944 it appeared that the CG-13A would play a limited role in AAF operations. Wright Field had received word that because of its high landing speed, the CG-13A was considered unsatisfactory in the CBI theater; and the heavy demand for CG-4A's in the extended glider program for 1945 took precedence over CG-13A production. ATSC District Supervisors and the CG-13A contractors were notified that production of the 30-place glider should be curtailed to allow an acceleration of CG-4A manufacture.[179] As has been noted, Northwestern's contract for the CG-13A was later reduced to a quantity of 50. On 24 October Wright Field notified AC/AS, M&S that it was believed total CG-13A production would be 137 gliders, 50 at Northwestern and 87 at Ford.[180]

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178. Chart, Prod. Gliders, in App. I.
179. R&R No. 1, Col. G. A. Hatcher, Prod. Sec. to Chief, Prod. Sec., WF, 28 Sep. 1944, in Glider & Misc. Airc. Br., Prod. Sec., WF; TWX TSBPR3H-10-46, WF to Dist. Supvrs., CPD and MCPD, 7 Oct. 1944, in ATSC 452.1, CG-13A Gliders, 1944.
180. Proc. Div., WF to AC/AS, M&S, Attn. Brig. Gen. E. M. Powers, 24 Oct. 1944.

Chapter VI

A. EVALUATION

The experiences of both procuring and producing agencies related in the preceding chapters of this study suggest the existence of certain major problems of general occurrence in the glider program.[1] The severity and number of these problems, as well as their persistence, gave rise to some rather strong criticisms of the glider program. Lt. Gen. W. S. Knudsen, for example, is reported to have described the glider situation of April 1943 by saying, "It stinks."[2] That other government and military officials believed or suspected the validity of such a view is suggested by the number of administrative reports prepared on the glider program.[3]

Unfortunately, not all of the criticisms of the glider program had a sound factual basis, and great harm appears to have resulted from some unfounded assertions. Judgments on aspects of the glider program, or on the program as a whole, are admittedly difficult to formulate. The pressure of wartime needs destroyed or curtailed the value of some former criteria, such as cost; and the glider program had no military and few commercial antecedents upon which to base comparisons or by which critics might measure progress. Nonetheless, certain problems of the glider program stand out, certain achievements are noteworthy, and it is possible to measure failures of the program against total accomplishment.

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1. A chart summarizing the glider production program is included as Appendix I to this monograph.
2. ICD, Asst. Chief, Proc. Dir. to Actg. Chief, Proc. Div., ICD, AF, 20 April 1943.
3. The bibliography for this monograph may be consulted for evidence of the attention given the glider program.

The problems of the glider program are too closely related to permit an absolute separation, but for purposes of discussion they may be listed according to the following seven aspects that appear to have caused major difficulty: (1) the urgent demands for quantity production early in the glider program and the succeeding uncertainty of requirements; (2) the lack of military experience with gliders; (3) the limitations imposed upon enlistment of industrial facilities for development and production work; (4) dissemination of engineering and production information; (5) tooling for production; (6) scarcity of materials and supplies; and (7) the control of production costs.

Requirements

By the time the United States recognized their military potentiality, gliders had already been successfully used by the Germans in combat operations. It was not surprising that military officials in the United States at first prescribed a vigorous glider program.

The first urgent requirement for gliders arose out of the needs of the glider training program and resulted in accelerated production of converted light commercial airplanes in 1941. In 1942 there was an urgent demand for tactical gliders to be used for training purposes. When this requirement was increased by a demand for the accumulation of gliders for contemplated offensive operations in active theaters, the total requirement exceeded the productive capacity of the facilities engaged in the glider program.[4] This, combined with General Arnold's insistence upon

4. See Chart, Prod. Gliders, in App. I, and statements of requirements, p. 77.

achievement of glider objectives, resulted in the adoption of drastic policies and measures to speed glider production. Led by General Wolfe, Materiel Center officials labored feverishly to keep pace with the increasing demands for tactical gliders. Under such circumstances Wright Field officials were probably startled in September 1942 to learn that further procurement of gliders was not "contemplated." That announcement was the beginning of a long period of fluctuation in requirements for tactical gliders.[5]

An account of changing glider requirements has been included in Chapter V. An examination of the details of these requirements leads inevitably to the conclusion that this uncertainty was a serious impediment in the establishment of a sound glider development and production program. Officials in charge of the administration of the glider program normally did not record their criticisms or complaints relating to the functions of higher echelons; but even without such documentary evidence the conclusion is inescapable that rapidly changing glider requirements forwarded to Wright Field added an increased burden of administrative work, caused expenditures for experimental gliders not produced, and made industrial planning exceedingly difficult. The amount of paper work and other duties involved in contract changes is too well known to require explanation. The MC-1 and MC-2 assault-glider projects exemplify the expenditure of money and effort on experimental gliders for which there was finally no requirement. And contractors were certain to

5. See, for example, R&R, Asst. Chief, Misc. Br. to Asst. Chief, Proc. Div., MC, WF, 2[illegible] April 1943.

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find it all but impossible to establish their requirements for personnel, facilities, materials, and tooling when the requirements for gliders were so unpredictable.[6] As Colonel Dickson said in August 1944, the acceleration program specified by higher authority at that time could not be easily achieved: "Some of these firms, particularly those have . . . reduced their force. They've got to build up again." Personnel released had secured jobs elsewhere, and the glider companies could not just go outside and "blow a whistle" to call in needed employees.[7]

Much of the uncertainty of glider requirements stemmed from the novelty of the glider program as a whole. The utility and design of gliders could be finally determined only by operational use; there was no large reservoir of experience to draw upon in establishing design, model, and quantity requirements, and changes were made upon the basis of discoveries made during the course of the glider program. Thus production of the CG-13A was curtailed at least in part because of its undesirability in the CBI theater; and until the AAF had successfully used the CG-4A in tactical operations, officials concerned with requirements could never be quite certain that the production of large quantities of that glider was desirable.[8]

Even more important than the enforced reliance upon current experience was the relationship between glider production and tactical operations. Although developed and produced by the AAF, the glider had

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6. Chief, Prod. Div., [illegible] to AC/AS, [illegible]D, Attn. Prod. Br., 17 Nov. 1943, in "AAF Glider Prog., Prod. Proc.," App. [illegible].
7. Phone transcript, Col. [illegible] Dickson and Col. L. [illegible] Bradbury, 26 Aug. 1944, in [illegible], Airc. Proj. Br., Glider File, [illegible], Prod. General.
8. For evidence of the trouble for the AAF as to utility and requirements problems see [illegible], [illegible], Misc. Br. to Asst. Chief, Prod. Div., [illegible], 20 April 1943.

a closer tactical relationship to other organizations than do the AAF. Its primary tactical use was as an operative weapon assisting in the achievement of objectives which were essentially the responsibility of the ground forces. As a result, the requirements for gliders were necessarily closely related to the tactical doctrines and operations of the ground forces. The frequent changes in and general uncertainty of ground force plans were therefore certain to cause fluctuations in glider requirements.

But whatever the reasons for uncertainty of requirements, the fact remains that the Materiel Command faced a problem not of its own making in attempting to establish a sustained glider program on a transilient basis.

Lack of Military Experience with Gliders

Unlike the powered-aircraft program of the AAF, the glider program was undertaken without benefit of past military experience. The use of the glider as a military weapon was an innovation of World War II, and in the United States even the civilian antecedents of this use were limited. In the development and production of military gliders there was available a small fund of knowledge obtained largely from Military Attaché reports and from the experience of civilian soaring enthusiasts. But, for the most part, glider development and many aspects of production were dependent upon guesswork, theory, ingenuity, and the experience gained as the work progressed.

To compensate for the scarcity of military men familiar with gliders and gliding, a number of experienced civilians were recruited to aid in

the direction of the glider program, notably Richard C. duPont and Lewin B. Barringer. The work of these men in the glider program illustrates one of the difficulties growing out of the lack of military experience with gliders. Civilians familiar with gliding and with men in the glider industry, when enlisted in the military glider program, were prone to conduct their business on a personal basis which circumvented military channels and procedures. When Maj. Felix duPont succeeded his brother, Richard, as Director of the Glider Program in AAF Headquarters in October 1943, IWD reported that it would be necessary to "attempt to educate Major duPont as to the necessary channels both engineering and contractual, much in the same fashion as did his predecessors."[9] It is questionable if the "attempt" was very successful in the case of Richard duPont, whose relations with the Albert Criz Company appear to have been a violation of the authority and functions of the Materiel Command and an almost total circumvention of military channels.[10] In fact, as has been noted earlier, improperly channeled negotiations for the Bowlus-Criz glider were so general and so troublesome that Col. F. R. Dent was moved to issue a vigorous protest. That the Materiel Center had also experienced the same problem much earlier was evident in a complaint registered by an official at Wright Field in August 1942. At that time the Technical Executive, Materiel Center, reported that Major Barringer continually conducts his business on an informal basis without going through the proper channels, and it sometimes takes considerable time-consuming effort to straighten

9. TT [illegible]-1-243, IWD to MD, WF, 9 Oct. 1943.
10. See pp. 42-51.

these glider matters out."[11] However the merit of this informality, the AAF procurement machinery was not geared to it.

A more important problem posed by the lack of experience with gliders was the determination of design features of tactical models. Without benefit of much experience, glider designs were certain to be drawn largely from unproved conceptions and changed extensively on the basis of experiences of using services. One of the most important factors affecting design features was the question of expendability, and on that there was not complete agreement. It was reported in April 1942 that General Arnold believed gliders should perform but one mission; for that reason he was said to regard the CG-4A as too expensive and too well engineered. At the same time General Chidlaw of the Materiel Division took the view that even if gliders made but one operational flight, they should at least be sufficiently safe to protect the troops carried.[12] The glider training program, involving as it did extended use of the CG-4A's material, suggested a fallacy of the "one mission" concept; and in addition Wright Field engineers worked on the theory that gliders were subjected to the roughest sort of treatment in operations and hence should be well engineered.[13] The policy of glider engineers prevailed, and on [illegible] October 194[illegible] it was reported that "gliders which carried [illegible] of the First Allied Airborne Army

11. [illegible], Memo. [illegible] to AC/AS (M), [illegible], 10 Aug. 1942, in AAG [illegible] [illegible] Corp. [illegible], AFD [illegible] to [illegible], 5 S[illegible] 1942, [illegible], Gliders.
12. Ltr., Asst. Chief, Mat. [illegible] to Asst. Chief, Proc. Div., [illegible], 20 April 1942.
13. Interview, Capt. [illegible], Glider Br., Eng. Div., WF, 12 Feb. 1945, Typescript in AMC Hist. Office.

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into Holland began arriving back in England today, the first of many hundreds scheduled to return for repairs."[14]

It may be assumed that the extent of the repairs necessary was considerably less than it might have been had the theory of complete expendability prevailed. As early as November 1942, a concerted attempt to refine the CG-4A was in progress. The Directorate of Military Requirements specified a number of needed changes, including longer and wider ramps and additional top and bottom windows, and on 24 November 1942 CTI-1044 directed the achievement of the required modifications.[15] In March 1943 Maj. Gen. Carl Spaatz forwarded an urgent request from Africa for landing and identification lights for the CG-4A. The Materiel Center was immediately directed to determine the most satisfactory lights and installation parts, to make a rush shipment of kits containing lights and parts, and to provide such lights on future production gliders.[16]

In May 1943 personnel of the Glider Branch of the Aircraft Laboratory witnessed combat maneuvers at Camden, S. C., and from their observations decided upon and initiated five improvements in the CG-4A: (1) more effective spoilers to reduce the lift at low speeds; (2) provisions for increased pilot protection in crash landings; (3) reinforcement of skids; (4) inclusion of an emergency escape door in the nose for the pilot and co-pilot; and (5) more effective tie-down fittings.[17]

In July 1943 the Office of the Special Assistant for the Glider Program

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14. Stars and Stripes, 26 Oct. 1944.
15. R&R, No. 1, AFDMR to AFDMT, AFRDB, and AFMAC, in turn, 16 Nov. 1942; R&R, No. 2, AFDMT to AFMAC, 18 Nov. 1942; CTI-1044, 24 Nov. 1942; all in AAG 452.1, Transport Gliders, 1942-43-44.
16. "Resume of AAF Glider Prog.," Exhibit I.
17. Airc. Lab. Weekly PR, 27 May 1943.

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specified the following minimum flight instruments required in all tactical gliders: altimeter; airspeed, bank and turn, and rate of climb indicators; magnetic compass; Pitot tube; and aircraft clock.[18]

But in spite of constant efforts to improve our glider, the using services forwarded frequent complaints on the CG-4A.[19] On 15 October 1943 the Glider Branch of the Production Engineering Section, Wright Field, notified all CG-4A contractors that AC/AS had directed a pronounced refinement of the gliders. Accordingly, a detailed list of some 25 modifications and procedures was submitted to the contractors. For the most part these instructions directed compliance with previously issued Technical Orders and Ross engineering changes.[20]

In the meantime a series of conferences were held with using services. These meetings were carried on through October and November 1943, and were attended by representatives of almost every agency interested in gliders. A conference of 10-13 November, for example, included representatives of AC/AS, Training, AC/AS, OCAC, Materiel Command, Air Service Command, Training Command, I Troop Carrier Command, Airborne Command, and the School of Applied Tactics at Orlando, Fla. This conference agreed on the essential features of a modified CG-4A, possibly to be designated CG-4D. Provisions for the safety and comfort of passengers predominated in the proposed changes and included a new nose built by Ludington-Griswold, Inc., of Seybrook, Conn.[21] On 24 November the Materiel Command reported that using

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18. "Resume of AAF Glider Progs.," Exhibit C.
19. The extensive work of the I Troop Carrier Command in testing, using, and recommending changes in the CG-4A has been outlined in a monograph prepared by that Command. "I TCC Glider Progs.," I, 146-89.
20. Chief, Prod. Eng. Sec., WCF to CG-4A contractors, 15 Oct. 1943, copy in "AAF Glider Progs., Prod. Proc.," App. K.
21. TC Memo Rept. ENG-51-40314-1, 27 Nov. 1943, ibid., App. 1.

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services were asking for numerous changes and ended that "the conception of what constitutes a CG-4A glider seems to be changing every few days."[22] Finally, on 19 January 1944, CCI-1504 outlined a series of required changes and froze the design of the CG-4A as modified.[23] In the meantime, Wood and Material Command engineers had undertaken the development of the CG-14A, which was expected to be an improvement over the CG-4A. In addition, the freezing of the CG-4A design in January 1944 was not adhered to as a permanent engineering policy; it was more properly a production aid which gave CG-4A contractors an opportunity to accomplish a given series of changes without the interruption of continuous minor changes. Although the glider designation was not changed to CG-4B as once contemplated, improvement of the CG-4A was a continuing project of the Aircraft Laboratory glider engineers. Among the most important changes were the incorporation of the Aeronca-Griswold nose and the Cory skid, modifications effected to increase the durability of the glider and specifically to afford a greater measure of crash protection. As of the time of preparation of this monograph (May 1945), engineers of the Glider Branch, Aircraft Laboratory were engaged in a project designed to further increase the CG-4A crash protection factor by an efficient combination of the Griswold nose construction and the Cory skid. These refinements were instituted as a result of operational experience with the CG-4A.[24]

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22. TT EXC-4660, Prod. Div., AC, AF to Prod. Br., T D, 24 Nov. 1943, ibid.
23. 3d ind. (basic unknown), Prod. Div. to Tech. Exec., C, AF, 28 Feb. 1943, in Glider and Misc. Aircraft Br., Prod. Div., AC.
24. Interview, Capt. [illegible], Equip., 19 Feb. 1945; Chief, Distrib. Sec., T D to CG, ASC, 16 May 1944, in AG 452.1D, Gliders.

By the summer of 1944 certain larger concepts relating to the size and design of gliders had begun to appear with the promise of performance. In May of that year AAF emphasized the fact that it was not until "fairly recently" that there had been "an accumulation of any appreciable knowledge of the proper tactical employment of gliders, and the detailed technical requirements involved."[25] At a conference of representatives of CCIA, AAF, and the Materiel Command in July 1944 it was the consensus that the CG-4A and "its coming successor, the CG-14 . . . more nearly met the tactical requirements than any of the other types." This was especially true because the C-47 airplane could satisfactorily tow them. Furthermore, it was believed that "there was very little, if anything, that the large gliders could do that could not be done better by a cargo airplane, such as the C-82."[26] In September 1944 the Development Engineering Branch of AAF reported that performance characteristics of gliders carrying payloads greater than 10,500 pounds were such that "an extremely large glider is considered of very limited military application." This decision was based upon problems relating to take-off and landing areas, and the necessary size and power of tug airplanes. AAF was therefore directed to set 10,500 pounds as the maximum payload permissible in gliders.[27]

The foregoing sketch of design changes is by no means an attempt to present a comprehensive account of the improvement of tactical gliders. Rather, the data presented represent a very small proportion of the history of design developments. But these data do illustrate to the extent to which

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25. R&R, AAF to CCAA, 10 May 1944, in AAG 452.1D, Gliders.
26. "Daily Activity Rpt.," Prod. Dr., AAF, 5 July 1944, in AAG, Airc. Proj. Dr. Glider File, 4.11C01, Negro.
27. Chief, Devel. Eng. Br., AAF to Plan. Div., AAF, 15 Sep. 1944, in AAG, Airc. Proj. Dr. Glider File, 4.1101, Req.

glider design was a product of current operational experience. Although continuous refinement of military aircraft in production is expected, the number of revisions and the attention devoted to changes in CG-4A design and related production techniques are fair evidence of the difficulty of building a satisfactory article from limited antecedents.

Limitations as to Industrial Facilities

The limitations upon the selection of industrial facilities for the development and production of gliders imposed a heavy burden upon officials charged with the administration of the glider program. The policy of AAF Headquarters to avoid interference with existing programs for metal or combat aircraft has already been noted. This restriction had far-reaching effects throughout the entire glider program.

The experimental program for training and tactical gliders was still in its infancy when one of the results of the policy became apparent. In June 1941 the Engineering Division at Wright Field summarized the difficulties of accomplishing preliminary negotiations for experimental gliders.

> The prosecution of this project has been extremely difficult at times owing primarily to the fact that the companies interested have never before had any business contracts with the Air Corps. It was necessary to laboriously, and at great expense of time and effort, bear with these concerns one step at a time through the negotiations, preparation of model specifications, preparation of drawings, contract details and clauses, etc. In almost every case it was necessary to give the ultimate in personal attention to the representative or company official; and owing to the fact that the project appeared of enormous proportions to most of these people, it was necessary to "stand by" during their period of "making up their minds." All of the foregoing adds up to the expenditure of a great deal of time and effort in the endeavor to give this project all possible expedited action.[28]

28. ED Memo Rept. EXP-M-51/AD530, A. d. No. 18, 9 June 1941; see also R&R, AC, Wash., to AF D..., 31 July 1942, in AAG, Airc. Proj. Br. Glider File, 4.110, General (Experimental).

These difficulties, serious as they were, proved only the beginning. Once contracts were let and experimental gliders built, the production capacity of the companies engaged in the training-glider program proved inadequate. During their work on experimental models these contractors had been able to make use of their experience with commercial gliders similar to those desired by the AAF; as a result objectives of the experimental training-glider program were met with a great deal less difficulty than were those of the tactical-glider program. When these contractors turned to production contracts, however, their facilities proved inadequate for the production of gliders in the quantity and at the rate demanded by the requirements of the AAF training program. In brief, the contractors had a beneficial familiarity with the engineering and design aspects of the development project, but they had never been called upon to produce gliders in the quantities required by the AAF. Consequently the Materiel Center was forced to seek other sources for training gliders. The search led to what might best be termed a compromise with the policy of noninterference with existing aircraft programs, since Aeronca, Taylorcraft, and Piper, all manufacturers of liaison aircraft as early as 1941,[20] were given contracts for training gliders.

The inadequacy of production facilities was not limited to the training-glider program. Production of the tactical CG-4A did not meet requirements, and the Cessna project was a violation of the rule against utilization of the companies manufacturing metal or combat aircraft.

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20. AC-678, Aero. Acceptances, 166-66.

The problem of producing satisfactory tactical gliders in sufficient quantities was aggravated by unsatisfactory performance on the part of some subcontractors. Here again, the mediocrity of most of the prime contractors was an obstacle, for the companies assembling gliders often had neither the skilled staffs nor the experience necessary to discover and correct the errors of their subcontractors. Because of its extensive use in the glider program, subcontracting might have been expected to cause even more difficulty than it did. Laister-Kauffmann, for example, subcontracted 90 per cent of the work on its CG-4A contracts. Anheuser-Busch made inboard wing panels for Laister-Kauffmann, the ATF Corporation made nose and center section fuselage frames, and Mohen Companies, Inc., supplied outboard wing panels and nose fairings. Steinway and Sons manufactured wings and tail surfaces for General Aircraft, and G. & A. Aircraft bought tail surfaces from H. Sachs and Son and wings from the H. J. Heinz Company. Heinz also made spar-cap strips for Ford. Two of the most successful subcontractors were De Ponti Aviation and the Villaume Box and Lumber Company, manufacturers of fuselage frames and wings, floors, and tail surfaces, respectively, for Northwestern Aeronautical Corporation. Pratt, Read and Company secured fuselages from the White Aircraft Company, and Timm subcontracted fuselages to the Barlow Aircraft Company. Timm also subcontracted some woodwork to a showcase and fixture concern, floor board assemblies to a furniture company, tail group woodwork to another furniture company, and wing panel sections to an ice box company. Prime contractors also performed subcontract work for each other.[30] These instances represent but a small part

30. "AAF Glider Prog., Prod. Proc.," App. V, passim; TC, Gen. Wolfe to TS, Mech., Subs. C/S, 11 Aug. 1942; TC, Proc. Div., MF to AC/AS, M & S, Atten. Pri. Con. [illegible] Powers, 24 Oct. 1944.

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of the story of subcontracting, but they suggest the extent to which the CG-4A contractors subcontracted work on the gliders. No criticism is intended of any of the subcontractors listed above. Considering the extent of subcontracting in the glider program, it is surprising that participants in the program did not attribute more of their difficulties to subcontractors. There were, however, generally recognized evidences of unsatisfactory work performed by some of the subcontractors. The Robertson glider crash at St. Louis in August 1943 was attributed to the failure of a fitting manufactured by a subcontractor in St. Louis, and in July 1944 the Inspection Division at Wright Field reported that "much of the difficulty experienced in the fabrication of gliders has been due to poor workmanship on the part of certain sub-contractors manufacturing glider parts."[31] The Materiel Command in effect admitted the serious problem posed by subcontracting in the glider program. In October 1943, following the crash of the Robertson glider, the Inspector General of the Materiel Command pointed out that "the AAF holds the prime contractor responsible for complete inspection of all purchased material except that which has received AAF source inspection." But the Materiel Command could conduct source inspection only "in special cases"; the inspection organization of the Command was not large enough to accomplish inspection of "all items in vendors' and subcontractors' plants." At the same time the Inspector General said it was "somewhat questionable, of course, as to how far a small plant such as Robertson could go in the 'systematic control of fabricating methods in the plants of sub-contractors and vendors.'" It was admitted that only the large prime

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31. IOM, Chief, Inspection Div. to Chief, Prod. Div., MC, WF, 6 July 1944, in Glider and Misc. Airc. Br., Proc. Div., WF.

contractors could send their inspection personnel to the subcontractors' plants. Furthermore, it was admitted that inspection personnel at Robertson had passed a defective part because of their incompetence.[32] In October 1944 a summary of the records of 11 CG-4A contractors stated that the inspection work performed by General and Ridgefield had been "fair"; Robertson and Laister-Kauffmann, "poor"; and the remaining seven companies, "good."[33] It should be noted that this report did not include data on the four companies whose CG-4A contracts were canceled, and that it therefore summarized the records of only the more successful contractors. From these data on inspection policies and competence it is readily apparent that the utilization of small, inexperienced prime contractors in the glider program created a very real problem relating to quality control. The smaller CG-4A contractors needed the assistance of numerous subcontractors to achieve production goals, but they often lacked the skilled inspection personnel and system to insure quality workmanship by their subcontractors. At the same time the Materiel Command was not able to control the quality of the work performed by these subcontractors. In effect, this meant that many of the parts incorporated in CG-4A gliders were not subject to adequate inspection, and the Materiel Command had no assurance that all of the gliders were structurally sound. The Robertson glider crash was tragic proof of the danger in such a deficiency.

The inadequate inspection procedures of many of the CG-4A contractors, as well as financial and other weaknesses, could be attributed in large

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32. 1st ind. (basic unknown), Inspector General, AC, WF to Chief, AD, AC/AS, M&D, 25 Oct. 1943, in "Glider Report," Vol. VI, sec. on "Accidents."
33. IOM, Proc. Div., WF to AC/AS, M&S, Attn. Brig. Gen. E. M. Powers, 24 Oct. 1944.

measure to incompetent management. The previously discussed production records of the various contractors indicate the extent of this problem. Ward, Robertson, National, General, and Babcock were outstanding examples of companies rendered inefficient by a lack of vigorous, expert direction. In April 1943 Brig. Gen. B. E. Meyers held that "most of the trouble in connection with the CG-4A glider program is due to incompetent management."[34] Unfortunately, aside from endeavors to have incompetent executives such as department heads replaced, there was little the Materiel Command could do. Much of the management problem was caused by the inability of the top executives and owners or stockholders of the companies. In such cases the Materiel Command could make recommendations for improvement, could give assistance in ironing out problems, and might even threaten cancellation; but officials of the command could ill afford to use a heavy hand in attempts to have top executives and stockholders, or owners, replaced. When companies such as Babcock, National, and Porterfield failed miserably in production efforts and faced progressive disintegration or collapse, the pressure exerted by the Materiel Command, usually by threats of cancellation, was certain to hasten or force changes in ownership and top management.[35] But in general the scarcity of eligible, capable manufacturers encouraged tolerance of management conditions which under more favorable circumstances should have led to prompt cancellation.

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34. Memo for US/W by Brig. Gen. B. E. Meyers, Dep. AC/AS, M&D, 17 April 1943, copy in "AAF Glider Prog., Prod. Proc.," App. F.
35. See 3d ind. (basic unknown), Col. [illegible] F. Volandt, AC, Wash., to Air Inspector, 19 Feb. 1943, in AAG 452.1A, Gliders.

The experiences of the Materiel Command in attempting to produce gliders by the engagement of "a rather strange assortment of contractors"[36] resulted in an equally strange assortment of suggestions, criticisms, and explanations relating to the glider program. Several of these are worth noting as illustrations of the complexity, confusion, and uncertainty which characterized the program. In March 1943 the Fiscal Branch at Wright Field in a brief report on the glider program included the following suggestion:

> It is apparent to anyone sitting back now and reviewing the glider program that it might have been an act of wisdom to have placed the CG-4A contracts in the hands of Cessna, Piper, Taylorcraft and Aeronca and the trainers in the hands of those inexperienced in aircraft, reversing the orders when the inexperienced members of the group had acquired practical knowledge in production.[37]

Such a suggestion was probably made without thorough consideration of the fact that the training gliders were urgently needed at the start of the glider program and hence the larger companies were required for their production. In addition, one may question how much "practical knowledge in production" the inexperienced companies would have gained from the manufacture of training gliders; certainly the manufacture of the CG-4A was a more complex task than the assembly of trainers. There was also a note of contradiction in the statement, made in the same report, that "it now becomes apparent in the light of present day conditions that the gliders could have been practically hand made and plant facilities not installed suitable for quantity production."[38] Had this been true, there would have been little advantage in arranging contracts

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36. Study of the Glider Prod. Prog., a report to The Air Inspector by Maj. Bert H. White and Capt. Charles H. Beeghly, 5 March 1943, p. 5, in AFSC Hist. Office /Cited hereafter as "Study of Glider Prod. Prog."/
37. IOM, Actg. Chief, Fisc. Br. to Chief, Proc. Div., Mat. Cent., 29 March 1943.
38. Ibid.

to give the inexperienced contractors "practical knowledge of production." And aside from the element of contradiction, it is interesting to note that had the Materiel Center initiated a production program primarily on the basis of hand manufacture, it would have been impossible to meet the greatly increased demand for gliders after March 1943 (the date of the report cited above).

Possibly the outstanding early criticism of the glider program was that of Maj. Bert H. White and Capt. Charles M. Beeghly, representing the Office of the Air Inspector. The investigation was made under orders of the Air Inspector and the report of the investigation was submitted on 5 March 1943. Many of the criticisms made were valid, and consideration of the report here is not intended as a negative evaluation of all the results of the investigation. Some of the accusations and other data contained in the report, however, suggest the complexity of the glider program and the danger involved in the formulation of hasty or absolute decisions pertaining to aspects of the program. Perhaps the most obvious error in the report is the statement that "Waco Aircraft Company got into the glider business by virtue of being the only manufacturer with whom experimental contracts were placed, to design and build an acceptable model."[39] Actually, as is clearly shown in another section of the same report,[40] there were four such contracts for the 8- and 15-place gliders. Somewhat more understandable, but nonetheless mistaken, was the attitude taken by the inspecting officers in the case of the Cessna project. After noting the cutback on the Cessna contract (from 1,500 to 750), the report suggests that "the reasons for

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39. "Study of Glider Prod. Prog.," p. 100.
40. Ibid., p. 2.

this action are not clear, considering the speed with which gliders were being furnished under this program."[41] Brief investigation would have revealed that the cutback was directed in line with the policy of noninterference with "combat and trainer airplane production," a policy clearly understood and recorded by the investigating officers.[42]

During the inspection of the Air Gliders plant at Barberton, Ohio, the investigating officers "noted that small wood components for rib sections were being cut out one at a time and individually sanded to fit. This slow, costly method of manufacture will not make for production in quantity nor at reasonable cost."[43] These comments may be compared to the Fiscal Branch view, previously noted, that "the gliders could have been practically hand made."

The report of Major White and Captain Beeghly indicates further that it was easy to attack costs but not easy to determine other criteria in judging the glider program. Throughout their 108-page report are repeated statements relating to salaries and excessive costs, in spite of the introductory note explaining that "this study was approached from the standpoint that the object of the glider program was to get gliders, and get them as soon as possible. Because of this urgency, it is recognized that unit cost is higher than would ordinarily have been necessary."[44]

Finally, criticisms of the glider program were not always beneficial, as is shown in an Engineering Division report on the investigation conducted by Major White. On 23 February 1943 the Engineering Division

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41. Ibid., p. 8.
42. Ibid., p. 3.
43. Ibid., p. 22.
44. Ibid., title page.

notified Colonel Dichman that Major White of the Air Inspector's Office, Washington, was visiting the plants of the CG-4A contractors and making, as he put it, "a personal inspection for General Arnold of the glider production program." In spite of the fact that the Norwestern Aeronautical Corporation was considered "one of the most efficient and capable contractors engaged in glider production," Major White had "submitted a very derogatory report" on that contractor. Major White had been contacted at the Northwestern plant on 15 February by Colonel Dent, and the Engineering Division's report said:[45]

> This individual [White] is very antagonistic and continually tries through inferences and insinuations to create situations that do not exist. It is believed Major White is a definite handicap to the glider production program and has done more to create unrest and disturbance than any other difficulties.... It is suggested that steps be taken to curtail the activities of this individual.

Having inspected 13 of the 22 companies to whom production contracts had been awarded, Major White concluded his investigation on 26 February and submitted his complete report a week later. Whatever its merit as a stimulant to corrective action, such a criticism, arbitrary in censure without cognizance of all the evidence, was certain to create a distorted view of aspects of the glider program. To the extent that such criticisms created unrest among manufacturers and provoked preparation of time-consuming replies, they interfered with production of gliders.

In spite of these criticisms and the handicaps of attempting production by the utilization of small, inexperienced companies, the restrictions imposed upon the Materiel Command in the engagement of

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45. ICM, Chief, Eng. Div. to Chief, Prod. Div., Mat. Cent., Attn. Lt. Col. E. W. Dichman, 23 Feb. 1943, in AFSC 333.1, Air Inspector, Inspector General, WF, 1942-43-44.

contractors had a number of beneficial results. The first and most obvious was the protection afforded to the existing combat and metal aircraft programs. At the same time, utilization of less competent industrial organizations in glider production set a pattern for possible future projects of similar nature and afforded experience in the resolution of procurement problems. And finally, the development of small facilities for glider production increased the value of the plants to the AAF as possible sources for subcontracted glider parts or other aircraft assemblies or related work, even in instances where the facilities had not proved especially efficient as prime contractors. This benefit was noted briefly in the Fiscal Branch report of March 1943.[46] Evidence of the existence of such an advantage was furnished by the engagement of Ridgefield, a minor CG-4A producer, as subcontractor to Waco, and by the participation of Laister-Kauffmann, Commonwealth, and Pratt, Read in a glider reconditioning program administered by the ATSC Maintenance Division.[47]

Finally, it should be noted that government-financed plant expansion was not a significant measure of the restriction imposed by the policy of noninterference with existing aircraft production. In April 1945 the ATSC Resources Control Section reported authorizations for expansion of glider assembly plants totaling some $2,800,000. Authorizations were made for machinery and equipment, construction, conversion, and land.

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46. IOM, Actg. Chief, Fisc. Br. to Chief, Proc. Div., Mat. Cent., 29 March 1943.
47. Interview, Capt. R. F. Fetters, Trainer and Cargo Br., Maint. Div., WF, 1 Feb. 1945.

Northwestern Aeronautical Corporation had the largest project in terms of money value--$1,043,728--followed by Waco Aircraft with $1,028,891. Other authorizations were as follows: Ford Motor Company, Iron Mountain, $457,057; General Aircraft, $143,797; Gibson Refrigerator Company, $96,355; and Laister-Kauffmann, $62,634. By April 1945 all of these projects had been completed except those of Ford and Gibson, and the latter two were near completion. Northwestern and Waco were the only contractors whose floor space for glider production was increased by government-financed expansion. At Northwestern a government-financed project provided 153,247 square feet of floor space out of a total of 175,782 square feet devoted to glider production. The government provided 175,221 square feet at Waco, where a total of 261,847 square feet was utilized in glider production. These figures on expansion of glider facilities may be compared to authorizations totaling approximately $847,000,000 for the expansion of airplane assembly plants and to a total of more than 60,000,000 square feet of floor space provided for airplane assembly. In the light of such a comparison there is no reason to believe that the utilization of small, inexperienced companies resulted in a disproportionate amount of government-financed facilities expansion in the glider program.[48]

Engineering and License Agreements

The ineffectiveness of Waco's engineering service, under the engineering and license agreements with the other CG-4A contractors, was a serious

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48. RCS-403, "AAF Industrial Facilities Expansions; Status, Progress, and Performance," 27 May 1945, pp. 1-3, in ATSC Hist. Office. For a comprehensive survey of the methods, extent, and results of facilities expansion for AAF production, see AAF Historical Studies No. 40: "The Expansion of Industrial Facilities under Army Air Forces Auspices, 1940-1945."

problem in the early days of the glider program. The CG-4A manufacturers made frequent complaints about Waco's performance. Ford and Timm both claimed that the services rendered by Waco did not justify the fees demanded.[49] In February 1943 Ridgefield (then known as Jenter Corporation) reported serious delays and problems as a result of the 3,500 engineering changes issued to that date on the CG-4A; 1,050 of these, according to the report, were corrections of drafting errors.[50] General Aircraft said that Waco engineering was of no assistance because neither Waco nor the Materiel Command had any "consistent procedure for expediting changes, particularly substitutions." General Aircraft said it was "impossible to get answers quick enough to cover critical shortages which occur in production." Ward said Waco's vandykes were "terrible" and its drawings full of numerous errors. Gibson was not so severely critical, but felt that a system of checking Waco's drawings before release would have aided glider production. Northwestern said that drawings due in July 1942 were not received from Waco until December.[51] As early as September 1942 there had been so many complaints that the Inspector General's Department requested an investigation.[52] On 7 October 1942 Colonel Dichman reported the results of a "thorough investigation" of Waco's engineering service. From that and subsequent documents it is possible to arrive at certain conclusions relating to the problem.

To begin with, Waco's engineering service was not always promptly or

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49. "Glider Report," Vol. IV, Pt. 1, pp. 200, 203.
50. Rept. on Prod. of CG-4A Glider, as of 27 Feb. 1943, by Jenter Corp., Corres., Contr. W535 ac-26597.
51. "Glider Report," Vol. IV, Pt. 1, pp. 220, 221-22, 225, 227.
52. Ibid., p. 185.

accurately rendered, and the CG-4A contractors were therefore handicapped in their attempts to get into quantity production.[53] Waco was not able to supply drawings as rapidly as originally promised, and numerous errors reduced the usefulness of the drawings delivered. In addition to Waco's changes in drawings and in specifications, numerous change orders were issued by Wright Field engineers; these necessitated additional Waco changes and contributed to what one contractor called "the continual and voluminous stream of changes sent to us by Waco."[54] Waco claimed, for example, that by the middle of August 1942 the Materiel Center had sent 946 change orders to the design contractor and had thereby made Waco's job more difficult. The Materiel Center appears not to have denied that such a quantity of change orders was issued, but did claim that many of the orders were necessary to correct errors in Waco engineering drawings.[55]

It would have been surprising if Waco's drawings had not been both numerous and inaccurate. With production contracts for the CG-4A let before completion of the experimental models, Waco was placed in a difficult position. While completing the experimental gliders and compiling and completing the data on them, Waco was expected to supply the other contractors with drawings and other data for production use. Under this pressure Waco was forced to rush through sets of production prints from the original experimental drawings. This task was further complicated by the addition of a large number of drawing revisions made necessary by changes in the vertical tail surfaces of the glider. At

53. Chief, PEB, Mat. Cent. to AC, Wash., Attn. AC/S (E), 7 Oct. 1942, copy in "AAF Glider Prog., Prod. Proc.," App. K.
54. "Glider Report," Vol. IV, Pt. 1, p. 227.
55. IOM, Gen. Wolfe to AC, Wash., Attn. C/S, 22 Aug. 1942.

the same time, Waco did not have sufficient qualified personnel to operate reproduction machines, and many of the vandykes distributed were illegible.[56]

It was also true that in their anxiety concerning production plans, the other CG-4A contractors made Waco's job more difficult by flooding the Waco plant with representatives bent on getting necessary engineering and production data at the earliest possible moment. The contractors were allowed to maintain personnel at Waco under the terms of the engineering and license agreements.[57] Waco officials reported that as many as 60 representatives had been in the plant at Troy at one time seeking information for their employers, that is, the other CG-4A contractors. In their haste to secure full and reliable information these representatives frequently upset the entire Waco organization.[58]

An additional difficulty was created by the Materiel Center's desire to rush production at Cessna and General. Twice officials of the Materiel Center removed Waco's experimental drawings from the plant and had them photographed, sending the prints to Cessna and General. Aside from the interference with Waco's regular work occasioned by that procedure, many of the drawings were found to be almost illegible upon their return to Waco's engineering department. In their haste to build the XCG-4, Waco had made numerous penciled drawings; when these were

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56. IOM, Chief, PES, Mat. Cent. to MC, Wash., Attn. AC/S (E), 7 Oct. 1942.
57. Engineering Assistance and License Agreement, Waco and General Aire., copy in "Glider Report," Vol. IV, Pt. 1, p. 189.
58. See Waco's complaint: ibid., p. 208.

photographed the repeated handling of the drawings smeared them. With other CG-4A contractors frantically calling for drawings, Waco had no time to have the originals redrawn, and blueprints made from them were unsatisfactory.[59]

For these reasons outlined above--overlapping experimental and production work, design changes, Waco's personnel shortage, the interference of contractors' representatives, and difficulties with penciled drawings--Waco's engineering services were not always prompt or accurate. In fairness to Waco it should be noted, however, that the picture was not so dark as some critics tried to make it. First, several contractors, notably Northwestern and Cessna, admitted real help from Waco's engineering service and recognized that the failures of that service were not attributable entirely to Waco.[60] In addition, most of the CG-4A contractors were far behind schedule in their own work, and it was natural that they should fix the blame for their plight upon agencies or factors beyond their control. In that connection, they probably made the most of Waco's unsatisfactory engineering service; in many instances the contractors "magnified the trouble." Timm, for example, reported by telegram in June 1942 that of some 2,500 drawings on the CG-4A, they had received only 1,416. Later it was found that Timm had no basis for the reference to the total number of drawings due. There were actually less than 1,500 drawings on the CG-4A at that time.[61]

Waco's performance was censured by Materiel Center personnel as well as by contractors. The Fiscal Branch report of March 1943 provided

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59. Ibid., pp. 178-80.
60. Ibid., pp. 213-14.
61. IOM, Chief, PES, Mat. Cent. to AC, Wash., Attn. AC/S (E), 7 Oct. 1942.

a further illustration of the tendency of critics seemingly to stumble on to criticisms of aspects of the glider program without consideration, or at least without mention, of more than a small part of the pertinent evidence. At one point in the report Waco was described as a company which had demonstrated "no aptitude for production management," although earlier in the same report Waco was listed as one of "the proven sources in aircraft." Whatever the net judgment on Waco as a corporation, the report was definite in its criticism of that company's engineering service. "According to the information procured from practically every member of the group," there had been "no substantial aid rendered by Waco," and that failure had "seriously handicapped the beginning of production."[62] Evidence compiled by the Fiscal Branch later in 1943, however, indicated that Waco's poor performance was largely a result of circumstances over which the company had little control.[63] Consideration of these circumstances, which have been discussed earlier, suggests the conclusion that Waco was capable of performing satisfactory engineering service in the glider program. The mere fact that gliders were built at all, in view of the handicaps attending the effort, is partial evidence of that fact. Whatever Waco's capabilities, however, it is doubtful if any larger, more experienced company could have supplied satisfactory engineering service under similar conditions. The production difficulties and delays caused by unsatisfactory engineering service may more properly be attributed to the early precipitancy of the glider program than to any incompetence on the part of the design contractor.

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62. IOM, Actg. Chief, Fisc. Br. to Chief, Proc. Div., Mat. Cent., 29 March 1943.
63. See "Glider Report," Vol. IV, Pt. 1, pp. 178-80, 213-27.

One further fact is worth noting in a consideration of the engineering and license system. Contractors who complained that they were delayed by Waco's failure to supply prompt and accurate data do not appear to have fully recognized the help they received through approved deviations. The urgent demand for gliders in 1942 and through most of 1943 led Wright Field officials to speed production by granting numerous deviations from Waco's specifications and drawings. This was especially common in connection with materials and with the methods used in the application of fabric and dope. It was not until November 1943 that strict adherence to Technical Orders and to Waco's specifications, drawings, and change orders was decreed as a result of "the many complaints from the Service." Even then, however, provisions were made for a continuation of approved deviations which did not affect the "structural integrity, maintenance, or interchangeability of parts of the gliders."[64]

Tooling

Failure of the government tooling program was one of the most severely criticized aspects of the glider program. Major White's report singled out the tooling program as a major failure,[65] and the CG-4A contractors insisted that in their attempts to get into production they had been seriously handicapped by the tooling problem. Babcock said the "reversal of policy" on tooling caused a delay in initial production of from 30 to 45 days; G & A Aircraft said their costs were increased and production was delayed; Northwestern blamed the tooling program for

64. Chief, PES, MC to CG-4A contractors, 18 Oct. 1943. See also "Glider Report," Vol. IV, Pt. 1, p. 214, par. 4.
65. "Study of Glider Prod. Prog.," p. 14 and passim.

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production delays; Ward pointed out that a shortage of tooling personnel made the problem exceedingly serious at that facility; and Robertson, Ridgefield, General, and Pratt, Read had similar complaints.[66]

The main facts of the cancellation of the Bromley tooling program have already been noted.[67] A more detailed account of the reasons for that cancellation is important.

The Bromley tooling program was initiated to provide for interchangeability of parts of the CG-4A glider manufactured by the various contractors. Originally Bromley was selected to design the master jigs and fixtures; subsequent negotiations resulted in the selection of Buell Die and Machine Company in Detroit to build the tools designed by Bromley.[68] In March 1942 the CG-4A contractors and the Materiel Center agreed upon the Bromley, or as it was sometimes called, the government tooling program. All contractors except Ford and Cessna were expected to participate, and as noted earlier, most of the manufacturers counted on the Bromley tools. Following a sudden increase in glider requirements calling for 1,500 gliders by 1 October 1942, the Materiel Center instructed the contractors on 1 June to start manufacturing CG-4A's. Contractors were to take all steps necessary, including building their own tools, to speed production. At that time the Materiel Center said, "Interchangeability is unimportant compared to completing gliders.... Materials and

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66. "Glider Report," Vol. IV, Pt. 1, pp. 166-73.
67. See pp.
68. IOM, Chief, PES to Chief, Contr. Sec., Mat. Cent., 8 July 1942; Chief, Prod. Control Sec., Mat. Cent. to Ford Motor Co., 10 Aug. 1942; memo for Chief, Tr. & Trans. Br., Mat. Cent. by Maj. E. W. Dichman, 9 Sep. 1942; copies in "A.F Glider Prog., Prod. Proc.," App. I; "Glider Report," Vol. IV, Pt. 1, p. 138.

processes such as plating and welding need conform to best commercial practice only." The contractors were told that the Bromley program would "eventually be adopted."[69]

During the summer of 1943 three developments conspired to prevent a return to or completion of the Bromley program. First, Bromley did not make especially good progress in the design of the tools. In May 1943 an official of the Production Division at Wright Field attributed the failure of the government tooling program to "the fact that the Bromley Engineering Company could not arouse the need for making simple production tools quickly. In the interest of getting gliders built, contractors were instructed on June 1, 1943 to manufacture their own tools and jigs."[70] There were other factors, however, in the cancellation. One of these was the belief, expressed in September, that interchangeability could be achieved without the Bromley program. In a memorandum to the Chief of the Engineering and Transport Branch, Colonel Dichman pointed out that a wing panel and tail surfaces of a CG-4A built by Waco had been installed on a fuselage from a manufactured by General. "Apparently there was no serious difficulty in making this installation." For that reason Colonel Dichman said: "it is not believed that extensive tooling for interchangeability is necessary." This decision appears to have been made with reference to

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69. Bulk., Int. Cont. to CG-4A contractors, 1 June 1943, copy in "AAF Glider Prog., Prod. Proc.," Jan. J; see also ICT, Chief, Prod. Div. to Chief, Insp. Sec., Int. Cont., 5 June 1943, in HQS, Airc. Proj. Br. Glider File, 4.110, General (Experimental).
70. ICT, Chief, PDS to Chief, Prod. Div., MD, MT, 11 May 1943, in AAFC 452.1, Glider Prog., General, 1942-43.
71. Memo for Chief, Tr. & Proc. Br., Mat. Cont., by Maj. E.W. Dichman, 9 Sep. 1943.

interchangeability of "main assemblies." On that basis Colonel Dichman recommended that the Bromley contract be canceled.[71] The fluctuation in glider requirements, itself one of the major problems of the glider program, was responsible for the third factor in the Bromley cancellation. On 14 September the Chief of the Contract Section, Wright Field, notified Bromley that it was believed there would be no further procurement of "any substantial quantity" of CG-4A's and "therefore extensive production tooling for contractors now holding orders for limited quantities of gliders will not be necessary." Bromley was asked to send representatives to Wright Field to negotiate the "revised requirements for production tools."[72] On 15 September the Chief of the Production Engineering Section reported that most of the contractors had provided "tooling of some measure" and recommended that the Bromley contract be cancelled.[73] As a result all of the Bromley program was canceled except the portion calling for designs. The designs were sent to Wright Field in November 1942,[74] although by that time the CG-4A constructors were well along with their own tooling, which was being coordinated by a committee at Wright Field.

The initiation and subsequent cancellation of the Bromley tooling program had two primary results in the glider program. First, even after taking into account the contractors' inclination to stress their problems, it is obvious that the tooling program caused delays in getting

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72. Chief, Contr. Sec., Wright Cent. to Bromley Air. Co., 14 Sep. 1942, copy in "Glider Report," Vol. IV, Pt. 1, p. 144.
73. Ltr., Chief, Prod. to Chief, Contr. Sec., Wright Cent., 15 Sep. 1942, copy in "AAF Glider Prog., Prod. Proc.," App. J.
74. "Glider Report," Vol. IV, Pt. 1, p. 139.

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into production. Second, interchangeability was in large measure sacrificed in the program of individual tooling.

It has been reasonably claimed that the failure of the Bromley program did not result in "long delays in production," and that, in fact, under existing circumstances the institution of individual tooling in the summer of 1942 "tended to speed up the production program."[75] As far as it goes, that view of the tooling program may be justified; Bromley's progress on the tooling contract was not satisfactory, and the contractors probably got into production faster with individual tooling than would have been possible had they waited for the Bromley tools. A more complete picture of the question of delays in production, however, necessitates consideration of the delay in getting the contractors started on their own tooling. An instruction to the glider contractors to begin their own tooling when the glider contracts were awarded would have prevented the delay occasioned while the Bromley program was in effect. Although the contractors did not rely on Bromley for all of their tooling, there is no doubt that they did refrain from a major effort in tooling, which they would otherwise have made had the government tooling program not been in effect.[76] It is therefore obvious that the initiation of the Bromley program and its existence as a factor in the glider program did delay production. Had the Bromley program not failed, it appears that the final result might well have been the achievement of interchangeability and a better all-around product at the expense of early production. Failure of the program after it had been in effect

75. Ibid., Vol. I, p. 146.
76. Ibid., Vol. IV, Pt. 1, p. 138.

for several months destroyed the advantage of interchangeability without glider quick production. That predicament could have been avoided had Materiel Center officials been able to foresee the failure of the Crosley program, but such foresight could hardly be expected. As it was, when the requirement for gliders was suddenly increased in the summer of 1942, procurement officials had no reasonable alternative but to go ahead with individual tooling even if it meant a sacrifice of interchangeability.

The question of interchangeability was one of the major issues of the glider program. A Materiel Command glider report prepared late in 1943 offered evidence of successful tests of interchangeability. A wing panel and tail surfaces manufactured by Waco were installed without "serious difficulty" on a fuselage frame made by General; CG-4A assemblies constructed by Ford were found to be interchangeable with those of other contractors, except for the fuselage nose section; and a check at the Victorville, Calif., glider school showed that there was "no particular difficulty with interchangeability." The same glider report, however, contained an admission that in response to the urgency of glider requirements in 1942 "Greene and others were given a free hand, and the day that this came interchangeability ceased to exist." The report summarized this aspect of the tooling question with the circumspect claim that "interchangeability had not been completely lost." The report also advanced the view that noninterchangeability of parts manufactured by different subcontractors for different prime contractors was not too serious a failure. As far as the "usability of the glider is concerned, the parts do not have to be identical for gliders as such are definitely expendable and, providing spare parts are made by the same manufacturer

who produces the glider, little maintenance difficulty will be encountered in the field of operation."[77] Such a view was not in harmony with the Materiel Center's early desire to achieve as great a degree of interchangeability as possible,[78] nor was it in very close agreement with the attitude of Materiel Center engineers whose development policies veered from the theory of expendability. In addition, the long service demanded of gliders in the pilot training program, if not sufficient immediately to destroy the concept of expendability, should at least have outlawed all attempts to minimize the need for interchangeability of parts. And finally, it is difficult to sustain the view that "little maintenance difficulty" would occur if spare parts were made by each contractor for his own CG-4A's. Even without reports of difficulty in the field, it is apparent that if interchangeability existed only among parts and assemblies manufactured by a given contractor, maintenance personnel would be required to keep a separate stock of spare parts for each contractor's gliders; the labor and time required for such a task are obvious. Further, with such a small degree of interchangeability the salvage of gliders and construction of new units from parts of scrapped gliders would be vastly complicated.

Reports from the field indicated that to maintenance personnel the lack of interchangeability was a serious problem. Early in 1943 the Maxton Army Air Base reported that parts manufactured by Ford, Cessna,

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77. Ibid., Vol. I, pp. 145-46.
78. See correspondence in "AAF Glider Prog., Prod. Proc.," App. J, part of which has been cited previously, in connection with tooling and interchangeability.

Waco, and General were not interchangeable.[79] On 16 March Wright Field recognized the problem by notifying AAF personnel at contractors' plants that it had "become necessary to establish a great degree of interchangeability between CG-4A glider units of different contractors." To insure improvement in the matter, all of the contractors were to be sent a CG-4A as a mating article.[80] Despite the obvious merit of such a procedure it did not insure satisfactory interchangeability. Almost a year later, in January 1944, the Air Service Command notified the Materiel Command that interchangeability had not been achieved even in parts manufactured by the same contractor. Maintenance Division of ASC said:

> The condition of current production of gliders with regard to interchangeability is considered deplorable. Admittedly, it is considered impracticable at this late date to require complete interchangeability of all items manufactured by the various contractors of the CG-4A gliders. It is, however, considered necessary that component parts and assemblies manufactured by the same contractor be capable of interchange, replacement and assembly by service activities.[81]

With added experience in manufacture and as a result of constant pressure by production officials of the AAF, the CG-4A interchangeability problem was gradually resolved in 1944. The use of a CG-4A as a mating article had in the long run a beneficial effect, although some instances of lack of interchangeability still plagued maintenance personnel through 1944.[82]

The I Troop Carrier Command believed that "the interchangeability of parts did not improve . . . until contracts with smaller manufacturers had terminated." This was based on the view that the

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79. Maint. Div., ASC to CG, Mat. Cent., 18 Feb. 1943, in Trainer and Cargo Br., Maint. Div., WF.
80. Telg., PES-2014, Mat. Cent. to Inspectors in Charge and AAFRR's at CG-4A contractors, 16 March 1943, copy in "AAF Glider Prog., Prod. Proc.," App. L.

different manufacturing techniques of the small, inexperienced contractors had resulted in noninterchangeability of parts.[83] It may be assumed that individual tooling was a major factor responsible for different techniques.

As may easily be discovered by consideration of the difficulties attending it, tooling was one of the two or three most formidable problems of the glider program. Basic tooling problems were multiplied in the glider program by the spread of CG-4A production over 16 contractors. The tooling problem may be considered an argument against the use of a large number of manufacturers.

Priorities and Materials

The difficulty experienced in obtaining materials and parts ranks with the tooling problem as one of the chief obstacles in the way of glider production. As early as June 1942 Production Division at Wright Field reported that the Materiel Center was "currently confiscating material and equipment already in the hands of other aircraft manufacturers." If necessary, training plane production would be slowed down to get gliders.[84] General Wolfe put it more candidly when he said, "I am stealing stuff right and left, and we will probably catch heck for it all the way around."[85] On 1 July the Chief of the Production Engineer-

81. Chief, Maint. Div., ASC to CG, AC, 12 Jan. 1944, in Trainer and Cargo Br., Maint. Div., WF.
82. Interview, E.D. Merritt, Trainer and Cargo Br., Maint. Div., WF, 6 Feb. 1945, typescript, in ATSC Hist. Office.
83. "I ASC Glider Prog.," Vol. I, pp. 227-28.
84. [illegible]-M-55, Brig. Gen. K. B. Wolfe, Prod. Div., Mat. Cent. to Maj. Gen. O. P. Echols, HQ, Wash., 4 June 1942, in ATSC 452.1, Glider Prog., General, pp. 142-43.

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ing Section reported a critical shortage of steel tie rods and said, "The problem of procuring materials for these gliders is serious."[86] On 1 August 1942 a Materiel Center official presented the problem in some detail. Pointing out that the success of the 1,800-glider program depended upon the acquisition of materials for the prime and subcontractors, the report summarized the raw materials problem as follows:

> Probably the most critical shortage of all . . . is that of steel--steel tubing, steel bar stock, and steel rod--in a number of different alloys. Cessna at the moment, for instance, is short on four steel tube sizes--and Cessna is the most important manufacturer in the program expects extremely preferential treatment. Other critical items which trace back to the steel shortage are tie rods and control cables, and subcontracted parts such as landing gear assemblies, etc. Spruce for spars and other members is another critical item. So is plywood. About the only material with which there has been no difficulty is fabric.

Such component parts as instruments and radios had not caused "too much difficulty" because they had been stolen from aircraft with low preference ratings. Tires and tubes were not so critical, since a change in the specifications had reduced the number of sets required from four to two.[87]

Maj. E. W. Dichman insisted that the chief difficulty was with the priorities systems of the WPB and "the way they work--or don't work."

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85. Phone transcript, Brig. Gen. K.B. Wolfe, Mat. Cent. and Col. A.L. Vollandt, MC, Wash., 4 June 1942, ibid. Also see TT PROD-I-99, General Wolfe to General Meyers, 18 July 1942, in AAS, Airc. Proj. Br. Glider File, 4.110, General (Experimental).
86. ICL, Col. O.R. Cook, Chief, PES to CG, Mat. Cent., 1 July 1942, ibid.
87. Memo for Col. Eckert, Exec. for Control, Prod. Div., Mat. Cent. by Capt. Selby Calkins, 1 Aug. 1942, copy in "AAF Glider Prog., Prod. Proc.," App. I.

In the beginning the glider program was given an A-1A Group VI priority. The 1,500 gliders on the accelerated schedule of July through September 1942 were then given an A-1A Group I rating. At that point the rating system was changed and the glider program received an AA-3 rating. This was later changed to AA-1. The priorities question was further confused by the doubtful value of the ratings themselves. Major Dickman pointed out that the ratings assigned were "extremely melodious terms" and carried promising connotations, "even if the materials were not forthcoming!" This problem was recognized in the report of an official of the Materiel Center who said the delivery of 1,500 gliders by 1 October 1942 "depends upon delivery of materials immediately--not upon the filing of new forms upon which new promises of deliveries can be made." What was needed, this reporter added, was "a WPB directive which will supersede everything else in the book."[88]

By the end of August 1942 there had been no CG-4A deliveries and the 1,500-program was far behind schedule. The Materiel Center "attributed the lion's share of the delay to lack of raw materials." It was believed that some of the materials problem stemmed from the rapidity with which the program was launched. In addition the difficulty of securing steel was partly explained by the fact that there were 87 different kinds of tubing in a CG-4A.[89]

In addition to the general struggle for materials, contractors other than Cessna suffered added shortages as a result of the preferred treat-

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88. Ibid.
89. TCM, Chief, Prod. Div., Mat. Cent., to HQ, Wash., Attn. C/S, 29 Aug. 1942.

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ment accorded Cessna in the summer and fall of 1942. As early as 1 August it was recognized that the emphasis placed upon Cessna's contract had "resulted in robbing other glider manufacturers . . . of glider materials." It was admitted that that situation had "already extended throughout the glider program, down to the smallest and newest training glider source."[90] A few weeks later the Materiel Center reported that as a result of Cessna's favored position, the other CG-4A contractors would be "considerably delayed."[91]

In May 1943, PES at Wright Field reported that there were sufficient facilities for CG-4A production, but "the availability of critical materials continues to be a serious problem." Shortages of tie rods, bearings, and X4130 steel for fittings were especially severe.[92] The shortage of steel tubing was so critical in July 1943 that Production Division officials predicted a cessation of CG-4A production unless remedial action was successful.[93]

Records pertaining to the glider program indicate, however, that the efforts of procurement officials and the glider industry succeeded in mitigating the severity of the materials problem in 1943.[94] In one sense, the problem may be said to have run its course. At the start

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90. Memo for Col. Eckert by Capt. Collins, 1 Aug. 1942.
91. TT PROD-E-143, Prod. Engr., Mat. Cent., to AC, Wash., Attn. Chief of Staff, 21 Aug. 1942, copy in "AAF Glider Prog., Prod. Proc.," App. E.
92. IOM, Chief, PES to Chief, Prod. Div., MC, WF, 11 May 1943, in AFSC 452.1, Glider Proc., General, 1942-43.
93. TT PES-4833, Prod. Div., MC, WF to Prod. Br., MD, [illegible], Attn. Lt. Col. L.E. Bradbury, 31 July 1943, copy in "AAF Glider Proc., Prod. Proc.," App. L.
94. Glider files after July 1943 contain no references to critical materials problems similar to those of 1942 and the first half of 1943.

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of the glider program contractors found no huge stock piles of materials upon which they might draw. Instead, the tremendous demand for materials of all kinds for use in the developing national war production program had brought a period of intense competition for supplies with the accompanying rating and priorities systems for enforced rationing. It was found that purchasers might expect a lapse of approximately 90 days between the call for materials and their delivery. A contractor or subcontractor had first to estimate his needs, and then orders had to be placed with suppliers of raw materials. These functions had also to be incorporated with the preference ratings and priorities in effect at a given time. Nor did the accomplishment of allocations and the placing of orders complete the process. Glider supplies had to await the fulfillment of orders based on higher priorities. Glider manufacturers might not begin to receive their materials until several months after the determination of the need.[95] When this normal delay growing out of general restrictions on supplies was complicated by changing preference ratings and priorities, the difficulty of securing materials was increased. In addition the small companies relied upon for glider production could not be expected to have an acquaintance or business connections with suppliers on a scale similar to that of larger concerns.

Until the glider industry could overcome the handicaps resulting from contractors' inexperience, and until allocations and orders resulted in a flow of materials, AAF procurement officials took drastic

95. The "time lag" explanation of materials shortages was outlined by Maj. R.J. Dunkin, Glider and Misc. Airc. Br., Proc. Div., WF in interview, 6 March 1945, typescript, in ATSC Hist. Office.

measures to obtain badly needed supplies. These procedures have been sketched in connection with Germany's accelerated production project. By the summer of 1943 there was a marked improvement in the flow of materials for gliders, and it was possible to replace the hectic methods of 1943 with more orthodox purchasing procedures.

Cost of the CG-4A

It is an accepted phenomenon of a war period that under the pressure of wartime needs certain criteria normally of great peacetime interest become secondary considerations. One of these is cost. This is not meant to imply that the cost of military items becomes of no importance in wartime; what is meant is that when urgent requirements for equipment or supplies make it impossible to meet all accepted standards of efficient production, economical production may be sacrificed in order to achieve other goals. There is, of course, no clear line of demarcation between excessive costs justified by military considerations and those attributable to errors of judgment or incompetent administration of production programs. In this fact lies an inherent danger, not only as it applies to the glider program, but as it affects all war production and all military programs—that is, the existence of an opportunity to counter criticism by claiming military necessity as grounds for unreasonable costs. For that reason, and because cost figures are one yardstick for measuring comparative performance in glider production, some attention to the cost of AAF gliders is relevant.

As has been noted earlier, the total cost of the experimental gliders developed or partially developed during the war was approximately

$6,200,000 as of 31 October 1944. Air Material Command officials were able to keep expenditures down to that low level is explained primarily by the fact that experimental gliders were built on fixed-price contracts, except for the XCG-18 and a few minor developments. Thus, at first glance the fixed-price contract has the appearance of a major advantage in the glider program. There can be no doubt that the policy of using that type of contract was of enormous value in preventing the excessive costs which the small, inexperienced contractors might well have accumulated. A number of contractors did, in fact, accumulate costs far in excess of the contract price, thereby indicating the governmental economy secured by the fixed-price agreement. This was at the same time, however, an argument against the rigid limitation of the AAF's liability, since it was conceivable that contractors on the way to a successful development might be forced to abandon the project because of financial failure. Such an eventuality was made less probable, of course, by the vigilance of project engineers who might be expected to perceive the beginning of a highly promising development and secure alleviation of the contractor's financial distress.

Aside from any possible restriction imposed by fixed-price contracts, the use of such agreements sometimes brought the AAF and its contractors into conflict over terms. The Read-York and Brigfel cases, previously described, are two outstanding examples of the ill will engendered by financial failures. Successful companies had their experimental costs amortized over production contracts, while unsuccessful contractors had little relief beyond the terms of the experimental contract. The Wichita Engineering Company, for example, stated that the contract price

of the XTG-10 was not enough to cover manufacturing costs, but the company expected a production order which would make possible the recoupment of losses on the experimental project.[96] There was no production of the XTG-10.

It bears repeating that contractors who accepted experimental contracts, knowing that the contract price would not cover manufacturing costs, voluntarily gambled on a production order. A decision as to whether or not the Materiel Command had any obligation to prevent contractors from jeopardizing their own welfare must rest largely upon the individual critic's philosophy of business ethics and of industry-government relations.

In the procurement of training and tactical gliders, where rapid production in large quantities was desired, contracts were let on a cost-plus-a-fixed-fee basis. With one exception training gliders were produced at surprisingly consistent unit prices. Piper's TG-8 was produced for $2,108 per glider, the lowest unit cost in the training glider program, while Laister-Kauffmann's TG-4A was the highest at $4,000, if the disastrous Air Gliders TG-3A is excluded. The Air Gliders contract was the worst mistake in the training glider program; the government paid that contractor nearly half a million dollars for one TG-3A delivered months behind schedule. Including the payment to Air Gliders, payments to training glider contractors totaled $3,406,400 for 1,096 gliders.[97]

The cost of the CG-4A was in many instances exorbitant. Unduly optimistic contractors' estimates in the beginning were the product of: (1) an understandable desire to offer the Materiel Center low cost

96. Wichita Eng. Co. to Chief, Proc. Div., MC, W, 23 April 1942, copy filed with A.O. 42-?711 in Contr. Files.

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quotations; and (2) inaccurate information upon which cost estimates were based. Production contracts were let before they had completed either the experimental articles or the design data relating to those articles. Under the circumstances the Material Center had no alternative but to "look with favor upon over-runs in such amounts as will be required in the completion of the gliders."[98] In February 1943 the Production Engineering Section at Wright Field reported that "the actual cost of manufacturing CG-4A Gliders is proving to be greater than the estimated costs in all cases." This was explained by the shortage of materials and the necessity for numerous substitutions of materials. In addition, "many small parts such as bolts and fittings which would ordinarily be purchased in the open market were made by hand in order to get gliders built."[99] In a memorandum for the Under Secretary of War in April 1943, General Myers referred to the inexperience of many of the contractors and said, "We have had to pay the cost of educating them." As a result, in many instances the cost of the gliders was "very excessive."[100]

By November 1943 some actual costs were running as high as 150 per cent of original estimates. Ford's original estimate of $18,923 per glider was the lowest quotation offered by the 12 original CG-4A contractors, and Ford was the only contractor able to produce gliders at a price lower than the estimate. The other 11 contractors were

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97. Chart, Prod. Gliders, in Doc. I.
98. IC , Actg. Chief, Proc. Br. to Chief, Proc. Div., 28 March 1943.
99. 1st ind. (name unknown), Chief, P&S to Asst. Inspector General, Hqt. Cont., 15 Feb. 1943, copy in "AF Glider Progs., Prod. Proc.," Arg. A-10.
100. Memo for USW by Brig. Gen. B.L. Myers, Doc. AG/43, [illegible], 17 April 1943.

accumulating costs far in excess of original quotations. When the contracts were awarded, the highest cost estimate was Gibson's quotation of $21,315; the others were slightly less. By November 1945 actual costs of 11 of the contracts were listed at increases ranging from 18 per cent (Waco) to 58 per cent (G & A). Ford's unit cost of $18,532 represented a decrease of 8 per cent. The highest figure was G & A's $33,971.[101]

By October 1944 unit costs had decreased, although only one-third of the major contractors had been able to make good on their original estimates. Commonwealth, Ford, Gibson, and Waco had proved by that date that they could manufacture a CG-4A for less than $20,000.

It is important to note that cost figures are at best reasonable estimates. One complicating factor arises from the fact that at any given time there is no assurance that all payments to contractors have been reported by scattered finance offices. When more than one glider model has been built on a contract, total payment records do not always indicate the amounts paid for each model. Furthermore, in the case of contracts in progress at the time of cost survey, the exact relationship between payments to date and deliveries is not easily determined. To this may be added complications arising from the use of advanced payments and from attempts to take into consideration unpaid obligations which may be changed by negotiations after the figures have been used. And finally, cost figures based upon total payments to contractors include payments for spares, while figures on unit cost issued by finance or

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101. "Glider Reports," Vol. I, p. 108.

fiscal offices usually deal with the manufacturing cost of the individual article. This distinction is especially important. Figures on unit cost of production articles quoted in previous chapters of this study were derived from total payments to the contractor and hence include future costs.

But whatever the inconsistencies of cost figures as a result of different derivations and incomplete data, such figures are of value in comparisons of performance, and when used in conjunction with related or similar figures have an acceptable validity. A table showing several sets of cost figures for the CG-4A is included on the following page. Examination of the table reveals that Ford's unit cost is the lowest of all the CG-4A contractors. Next in order are Waco, Gilson, and Commonwealth. It may be assumed that the high cost of CG-4A's built by Meister-Bruckmann, Robertson, and Ridgefield is due in part to the fact that these companies produced small quantities of gliders. Initial problems of tooling, personnel, facilities, and other aspects of production planning were largely the same for all contractors. The companies holding contracts for large quantities of gliders had an opportunity to spread heavy initial costs over extended production; this was an advantage denied the contractor whose production was limited. It is also obvious that the manufacturers of large quantities of gliders had certain advantages common in mass-production techniques, such as the purchase of larger quantities of supplies at lower cost and more extensive use of better machinery and tools in manufacture.[102]

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102. Ibid., pp. 106-07.

TABLE

CG-4A Unit Cost

Contractor	Mfg.cost.[a]	Mfg. cost plus crating & fee.[b]	Cost based on total payments.[c]	Total no. delivered to 31 Oct. 1944.[d]
Ford	$14,000	$15,580	$14,891	2,418
Waco	17,539	20,037	19,367	999
Gibson	19,066	21,595	25,785	1,055
Commonwealth	19,868	23,431	24,232	1,050[e]
Northwestern	23,015	26,147	24,543	887
G & A	24,266	27,429	25,144	464
General	27,076	30,210	31,010	1,013
Ridgefield	27,285	30,365	38,209	155
Robertson	27,964	31,226	39,027	147
Pratt, Read	28,852	30,663	30,802	925
Laister-Kauffmann	---	27,528	29,437	210
Cessna			30,324	750
Babcock			50,906	60
Timm			51,123	433
Ward			379,457	7
National			1,741,809	1

a. IOM, Proc. Div., WF, to AC/AS, M&S, Attn. Brig. Gen. E. M. Powers, 24 Oct. 1944, in App. VI. These figures, showing the cost of manufacturing a CG-4A, were prepared by Contract Audit Section, Procurement Division, Wright Field. They are based chiefly on contractors' production in 1942 and 1943.

b. 1st ind., (basic unknown), Chief, Proc. Div., WF, to Chief, Proc. Div., M&S, 25 Sep. 1944, in Glider and Misc. Airc. Br., Proc. Div., WF. These figures, compiled by Contract Audit Section, also represent performance in 1942 and 1943; they include manufacturing and crating costs and fees paid the contractors.

c. From Chart, Prod. Gliders, in App. I. Cost figures include spares. For contracts still in progress on 31 October 1944 unit cost figures are especially unreliable (Robertson, G & A, Northwestern, and Ford). Cost figures in column 4 were based upon deliveries shown under column 5; costs in columns 2 and 3 were based upon only a portion of total deliveries shown under column 5.

d. Chart, Prod. Gliders, in App. I.

e. Includes 100 CG-3A's.

In view of the size of the contracts involved, the unit costs of the gliders produced by General and Garrett, Ford are excessive. Because they were high-cost producers, neither General nor Brooks, Ford was considered for a cost-plus-a-fixed-fee contract in the extended glider program for 1943.[103] As noted earlier, General accepted a fixed-price contract for 100 CG-4A's. The contracts of Babcock, Timm, Ford, and National were cancelled. Of these, Babcock and Timm accumulated excessive costs in quantity production, while Ford and National were not able to manufacture sufficient gliders to warrant consideration of their performance in terms of production costs. Payment of more than $1,700,000 to National for a return of one CG-4A stands with the Air Gliders CG-7A contract as a prime example of the cost of awarding contracts to "companies on paper." The payment to National also represents in part the cost to the AAF of the fallacious judgment which caused continuation of National's contract when that contractor's facilities and procedures were very nearly ludicrous.

The cost of erecting a CG-4A, computed on the basis of production in 1942 and 1943, ranged from $1,280 (Ford) to $2,084 (Commonwealth). For the same period the fees paid the contractors varied from $287 per CG-4A (Frank, Ford) to $877 (Robertson).[104]

In September 1944 the Procurement Division at Wright Field estimated that the CG-13A's on Ford and Northwestern contracts would cost

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103. IC., Proc. Div., WF to AC/AS, MMS, Attn. Brig. Gen. E. M. Powers, 24 Oct. 1944. (basic unknown)

104. 1st ind/ Chief, Proc. Div., WF to Chief, Proc. Div., MMS, 25 Sep. 1944.

approximately $50,000 each, plus a 4 per cent fixed fee.[105]

At the same time the Division set $30,000, not including export boxing, as the maximum which would be paid for a CG-4A on fixed-price contracts.[106] By estimating crating costs at $2,000 per glider, it is possible to arrive at a quotation of approximately $32,000 per glider, a figure which may be accepted as the Procurement Division's view of a reasonable price for the CG-4A. This may be compared to the estimated unit cost of $25,445 (including spares) for the 10,649 CG-4A's and CG-4A's delivered to 31 October 1944.[107]

In November 1944 Colonel Dichman observed that the "unit costs of CG-4A gliders currently being produced are approximately two-thirds of the unit cost for the initial procurement of these gliders."[108] It was apparent at that time that the accumulated experience of the contractors and larger quantity production had resulted in more economical manufacture. The cancellation of the most ineffectively executed contracts, as in the cases of Timm, Babcock, and Ward, had prevented some excessive costs, and in the latter part of 1944 procurement officials adopted a policy of protection against excessive costs by contractors still in the glider program. This measure of protection was achieved by awarding fixed-price contracts to such high-cost producers as Laister-Kauffmann, General, Robertson, and Pratt, Read.[109]

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105. Ibid.
106. ICD, Proc. Div., WF to AC/AS, A-3, Attn. Brig. Gen. E. P. Powers, 24 Oct. 1944.
107. See Chart, Prod. Gliders, in App. I.
108. [illegible] 11-91, Col. Dichman to AC/AS, A-3, Attn. Maj. W. P. Hoyt, 14 Nov. 1944, in Glider and Misc. Aire. Br., Proc. Div., AF.

While these improvements in cost policy and in performance offered promise of economical production in future programs, they could not alter the record of excessive costs accumulated during the first two years of tactical glider production. The excellent cost record of the Ford Motor Company reduced the average cost for CG-4A manufacture, but at the same time it had the effect of emphasizing the high costs of most of the remaining contractors. Especially in view of Ford's performance, the average unit price of more than $2[illegible],000 appears unreasonable; certainly it did not meet original estimates of fair costs and it did not conform to Wright Field's final opinion on a reasonable price. Considered wholly apart from influences or cause, neither the expenditure of some $376,357,000 for 10,596 tactical gliders nor payments totaling $3,403,400 for 1,086 trainers can be interpreted as a satisfactory procurement accomplishment. The entire matter of costs is, of course, too complex to permit the quotation of exact figures representing ideal performance.

Numerous factors hold a share of the responsibility for excessive costs. Such problems as the inexperience of contractors, material shortages, fluctuating requirements, the inconsistency of tooling procedures, and ineffectiveness of engineering service and license agreements have already been considered at some length. Production records of the individual contractors suggest further that the policy of

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109. As forecast by the Procurement Division, WD (see p. 101), increased requirements for gliders resulted in the recall of Pratt, Read as a CG-4A contractor early in 1945. RC-1035, Corrections to Working Schedule W-12, 31 Jan. 1945. According to information supplied by Glider and Miscellaneous Aircraft Branch, procurement of 373 CG-4A's on Pratt, Read's new contract was initiated on a fixed-price basis.

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cordingly, glider procurement over a large number of sources resulted in high costs, as well as in multiplication of other problems. The award of contracts to such inexperienced companies as National, Babcock, Air Gliders, Robertson, and Ford finally resulted in payments totaling more than $13,000,000, for 616 gliders. Had the money and effort expended in "nursing along" such obviously incompetent contractors been used to assist the production of more promising companies, there is little reason to doubt that glider production would have been increased and costs reduced.

Conclusion

On 3 November 1939, Col. E. E. Wimperis of the British Air Ministry and Imperial College of Science, London, wrote to Maj. T. H. Rowe, Chief of the Engineering Division at McCook Field, Dayton, Ohio:

> I went down to see Capt. Hill to see the Glidin[illegible] but unfortunately the particular day I selected was one of too high a wind and the one glider that did go up had to land tail first! I wonder if you are thinking much about these little machines. Personally I have great hopes of their being a most useful adjunct to ordinary flying.[110]

Twenty-two years later a Burma correspondent of the London News Chronicle wrote:

> Flying over mountains 6,000 ft. high, American glider pilots are evacuating British wounded from a strip cut out of jungle swamp.

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110. Col. E.E. Wimperis, British Air Ministry, London, to Maj. T. H. Rowe, 3 Nov. 1939, in AAHC 371.68, Bombardier, 1939.

> In five days they have taken out 298 severely wounded and sick men, many of whom would have almost certainly died if they had been driven by road to the nearest base hospital.
>
> The journey by glider takes one hour and ten minutes--by road it takes 11 days or more by elephant, mule or lorry with broken springs.[111]

British soldiers evacuated from the "Green Hell of Asia"[112] can vouch for the excellence of Colonel Wimperis' foresight. That serious thought on gliders came late in the United States may be evidence of a lack of foresight here, but in turn it need not detract from the worth of the American glider effort once it was made.

The overseas deployment of gliders as of September 1944 is shown in the following table:[113]

Gliders on Hand (AAF and Allies), En Route, and Committed to Theaters

	On Hand	En Route	Committed
MTO	103	--	--
ETO, CG-4A	3,119	496	--
ETO, Horsa	181	--	--
Far East	109	51	749
CBI, U.S.	315	27	150
CBI, British (Lend Lease)	450	150	--

As of November 1944 the CG-4A was the only AAF glider in use in ETO.[114] As has been seen, the CG-13 had been used in Burma in addition to the CG-4A. In ETO the CG-4A had proved superior to the British Horsa. Maintenance on the Horsa was "several times greater than that required on CG-4A gliders over any given period of time," and in one major operation, 36 out of 47

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111. London News Chronicle, 27 Oct. 1944.
112. Ibid.
113. From Tab "A" to memo for C/AS by Maj. Gen. H. A. Craig, AC/AS, OCAR, 16 Sep. 1944, in AFHC Hist. Office.
114. Memo Rept. ISEAL-2-4561-1-12, 30 Nov. 1944, in Eng. Div., Airc. Lab., WF.

British Horse

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fatalities due to glider accidents occurred in Horsa gliders. In CBI, the CG-4A was pronounced "satisfactory 'as is'," and was expected to prove useful in future operations.[115]

One need but examine the public records of past operations--Burma, the invasion of southern France, Normandy, and Arnhem--to discover that the glider as a tactical weapon has made its place. The AAF program which provided these gliders has been severely criticized, and often with undenied justification. The glider program was in some respects poorly managed. Especially in the production of gliders the cost was excessive. The problems of glider production were severe. But judged in relation to the part gliders have played in defeating a stubborn enemy, the glider program was, in a general sense, successful.

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115. Ibid.; R&R, Col. G. A.Hatcher, Prod. Sec. to Chief, Prod. Sec., WF, 28 Sep. 1944, in Glider and Misc. Airc. Br., Proc. Div., WF.

G L O S S A R Y

AAFRR	Army Air Forces Resident Representative
AAG	Air Adjutant General, AAF Headquarters
AC/AS	Assistant Chief of Air Staff
AMAC	Materiel Command
ASC	Air Service Command
ASDAR	Director of Military Requirements
AFRAS	Air Support Branch
Airc.	Aircraft
AMAB	Army-Navy Munitions Board
ATSC	Air Technical Service Command
CAA	Civil Aeronautics Administration
C/AC	Chief of the Air Corps
CBI	China Burma India
CPD	Central Procurement District
CTI	Classified Technical Instruction
DC/S	Deputy Chief of Staff
DPC	Defense Plant Corporation
EES	Experimental Engineering Section
EPD	Eastern Procurement District
Exp. Eng. Br.	Experimental Engineering Branch
IDM	Inter-desk memorandum
IGD	Inspector General's Department
IOM	Inter-office memorandum
Mat. Cent.	Materiel Center
MC	Materiel Command
MCPD	Midcentral Procurement District
MD	Materiel Division
MMAD	AC/AS, Materiel, Maintenance and Distribution
M&S	AC/AS, Materiel and Services
NACA	National Advisory Committee for Aeronautics
OCAR	AC/AS, Operations, Commitments and Requirements
PES	Production Engineering Section
Proc.	Procurement
SCO	Statistical Control Office
SEPD	Southeastern Procurement District
TCC	Troop Carrier Command
TI	Technical Instruction
Tr. & Trans. Br.	Training and Transport Branch
WF	Wright Field
WPB	War Production Board
WPD	Western Procurement District

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