

Development and Use of the Waco CG-4A Cargo Glider Deceleration Parachute

Compiled by Charles L. Day and Leon B. Spencer
Edited by William T. Milanovits and Marion "Smokey" Miller

One of the biggest problems facing the architects of the USAAF World War II Glider Program was finding a means of safely landing and stopping a fully-loaded and frequently overloaded CG-4A glider in some of the small fields of occupied Europe. To compound the problem, many of the glider landing zones in Normandy, France, was surrounded by earthen hedgerows on which grew 40 to 60 feet trees. During tactical flight training glider pilots were taught the techniques of losing altitude quickly; i.e., slowing the glider to just above stall speed, while at the same time using the wing spoilers and/or side slipping the glider. But side slipping a heavy glider close to the ground could be very dangerous. In addition to losing altitude quickly, a means of stopping the glider ground roll was also essential. Unless a solution to this dilemma was found quickly, many glider pilots and their passengers were in danger of being injured or killed during combat landings. Headquarters, USAAF assigned the task of finding a solution to the problem to the Glider Branch of the Aircraft Laboratory at Wright Field, near Dayton, Ohio.

By the fall of 1942 the Test and Experiment people of the Glider Branch at Clinton County Army Air Field, Wilmington, Ohio, had begun testing a 24 foot air brake parachute on the CG-4A glider (See Exhibits "A" and "B"). Elwin Gardner, crew chief for the first XCG-4 and XPG-1 (powered glider) test flights, said in 2002 that he still remembered some of these 1942 deceleration parachute tests. Similar air brake tests had been successfully conducted by the Army Air Corps on powered aircraft as early as the late 1920's at McCook Field, Dayton, Ohio. These tests proved that deploying the tail parachute significantly reduced the landing roll of the aircraft.

Just before Easter in 1943 the Chief of the Personal Equipment Laboratory at Wright Field, summoned William Milanovits, a mechanical engineer in the Parachute Branch, to his office. There he was introduced to Richard duPont, Special Assistant in Charge of the Glider Program, in Washington, DC. Milanovits was instructed by his boss to provide duPont with whatever he needed. The latter explained that he wanted a deceleration parachute that could be installed on the tail section of a Waco CG-4A glider that would increase its rate of descent with no increase in airspeed. This same parachute was also expected to reduce the ground roll of the glider.

Mr. DuPont suggested that Milanovits use his own discretion in determining the size of the parachute canopies needed for the flight tests. Communication between the two was strictly verbal. No written request was ever provided. After assuring duPont that he would move expeditiously on the project, Milanovits phoned Otto J. Mink of Reliance Manufacturing Company in Chicago, and placed an order for a series of parachute canopies ranging in diameter from 4 to 14 feet. Mink, a vice president and sales representative for Reliance, was a

frequent visitor to Wright Field. Reliance was a reputable parachute manufacturer that supplied parachutes for the U.S. Army paratroopers. Milanovits personally designed a suitable pack for the 14 foot canopy, but allowed shop personnel to fabricate packs for the remainder of the canopies.

To provide easy access to the cables running to the cockpit, Lab personnel decided to install the parachute on the left side of the tail section approximately two inches aft of the rear inspection opening. Lt. Marion "Smokey" Miller, CG-4A project engineer in the Experimental Engineering Section of the Aircraft Laboratory at Wright Field, was assigned the task of designing the deceleration parachute release mechanism. The original mechanism used in early tests had no vertical or horizontal braces to the airframe because the design considered only a straight line pull by the parachute when deployed. In the initial tests the suspension lines were hooked directly to a swivel installed on the tail of the glider.

Richard duPont piloted the CG-4A for the flight tests conducted at Wright Field. The initial test flight with the 14 foot canopy almost stalled the glider and was deemed unsatisfactory. The 12 foot parachute also proved unsatisfactory. Subsequent tests proved that the 10 foot parachute was the most effective, even though, when deployed the erratic movement of the chute caused the glider tail to swing back and forth. This problem was corrected by installing a 25 foot leader between the bottommost point of the combined shroud lines and the glider tail swivel.

Because of the additional bulk of the 25 foot leader a new parachute pack had to be developed. Milanovits supervised the cutting and shaping of the new pack and its fabrication by shop personnel. It was mounted on a duck-covered board to give rigidity to the pack and also provide a means of attaching the assembly to the glider. When the pack was completed he directed the positioning of the 25 foot extension leader and canopy, as well as the packing sequence of the flap closures and positioning of the elastic cords, etc. During flight tests the new pack functioned flawlessly, increasing the descent of the glider and shortening its landing roll after touch down.

Following the final test flight the required documentation was prepared, resulting in Technical Order No. 09-40CA-36, "WACO - Installation, Inspection and Operation of Deceleration Parachute - CG-4A." Installation procedures were outlined, parachute packing procedures were described step by step, photographs were taken of each step, and a number of drawings were prepared. T.O. No. 09-40CA-36A was first issued on 10 April 1944, with subsequent modifications on 9 June 1944 and 1 November 1944.

After the successful tests, Richard duPont contacted the Parachute Branch and requested that 400 10-foot parachute assemblies be purchased. Milanovits summoned Mink to Wright Field where he provided him with the "one and only" parachute assembly sample and placed a verbal order for 400 like items, assuring the latter that the appropriate paperwork would follow. The disposition of these 400 parachute assemblies is uncertain, but they were obviously field installed on CG-4A gliders both in the U.S. and overseas. Several former WWII glider pilots confirmed that they flew combat missions in CG-4As equipped

with deceleration parachutes, notably the Normandy, Holland and Rhine missions, but many of the CG-4A's used in the invasion of Sicily were known to be equipped with deceleration chutes. There is some evidence that appreciably more than the initial 400 parachute assemblies were subsequently ordered.

Exhibit "A" shows the original air brake parachute package believed by Elwin Gardner to have been installed on a CG-4A for flight tests that were probably conducted in late 1942. The A.C.42 markings on the 24 foot T-5 chest pack parachute indicate that it is an Air Corps parachute manufactured in 1942. The parachute release mechanism, designed by Lt. Miller, used a single tube attached to the airframe of the glider tail. Note the makeshift parachute ripcord shown in the left rear inspection opening. The results of these tests are not known, but the canopy size indicates that it was intended as an after touchdown air brake rather than being released at altitude.

Exhibit "B" shows a CG-4A just after touchdown with the 24 foot parachute deployed. It worked well as an air brake to slow the forward progress of the glider after landing. These tests preceded the deceleration parachutes ordered by Richard duPont.

Exhibit "C" shows the final configuration of the deceleration parachute installation on a CG-4A. Notice the rectangular pack, the improved release mechanism at the rear of the glider where double tubing both horizontally and vertically was used. Double tubing was employed because of the forces created by the parachute and the movement of the glider tail in flight. Also, the release mechanism appears to be sturdier and simpler in function.

Following the test flights at Wright Field and Clinton County Army Air Field, tactical field tests were conducted at Laurinburg-Maxton Army Air Field, North Carolina, so glider pilots could develop some experience with the deceleration parachutes. Former Pfc Robert A. Burns, a glider mechanic from Fort Worth, Texas, said in 2002 that he remembers installing a deceleration chute on a CG-4A at LMAAB in August or September 1943.

Exhibit "D" is an official USAAF photograph showing a CG-4A in flight over Clinton County Army Air Field with a 10' deceleration parachute deployed. Interviews in October 2002 with glider pilots who flew the Normandy mission, and one who flew the Rhine mission, said that their gliders were equipped with 8 foot deceleration parachutes. It is believed that they were, in fact, 10 feet in diameter, not 8 feet. No evidence has been found to indicate that an 8 foot deceleration parachute was ever prescribed for the CG-4A. However, evidence does exist that perhaps some gliders were equipped with deceleration parachutes that were less than 10 feet in diameter.

A case in point was a CG-4A in which S/Sgt Howard W. Johnson was a passenger on 18 September 1944. Sergeant Johnson, a glider mechanic assigned to the 71st TC Squadron, 434th TC Group, based at Mourmelon-le-grand, France, stowed away in a glider participating in Operation Market-Garden, the invasion of Holland. The glider, flown by Lt. Bill Snyder, landed safely near Zon. Before returning to England, Johnson removed the deceleration parachute from the glider and in February 2003 still has the parachute in his possession. A let

ter from him revealed that the canopy was only 8 feet 9 inches in diameter and consisted of 12 panels that measured between 28 and 29 inches in width at the perimeter of the parachute.

Exhibit "E" depicts the standard deceleration parachute installed on a clipped-tail CG-4A (the normally rounded tail was cut off at 45 degree angle) on display at the Silent Wings Museum in Lubbock, Texas. Note the double horizontal and vertical tubing supporting the parachute release mechanism. This glider was manufactured by Ford Motor Company at its Willow Run, Michigan plant under a Fiscal Year 1945 contract.

Early in fiscal year 1945, Wright Field issued a change order to three of the companies building gliders requiring the addition of 10' deceleration parachutes on future CG-4As. Waco Aircraft Company, Troy, Ohio, was to begin adding the parachute on all gliders starting with serial number 45-5201 and subsequent gliders; Northwestern Aeronautical Corporation, Minneapolis, Minnesota, on all gliders starting with serial number 45-5661 and subsequent gliders; and Ford Motor Company, Willow Run, Michigan, on all gliders starting with serial number 45-6016 and subsequent gliders. The change order affected only 1,075 gliders, which represented only a small portion of the 13,903 delivered to the USAAF during World War II.

The 10 foot deceleration parachute canopy, Part No. 44G5496, ordered by T. O. 09-40AC-36 was circular in design and had 12 suspension lines. Each suspension line started at the edge of the vent band, crossed the vent, extended all the way down one side of the canopy, through a loop, back up the other side of the canopy, and ended at the vent. The base of the suspension lines was formed into a single loop on which was attached the 25-foot leader.

A list of the materials used in the fabrication of the parachute canopy is as follows:

(1) Fabric	Nylon, 2 ounces per square yard	AAF Specification 16133
(2) Suspension	Nylon Webbing, ½ inch wide, 1000-lb tensile strength	AN Specification No. AN-W-10
(3) Riser	Nylon Webbing, 1 inch wide, 3000-lb tensile strength	AN Specification No. AN-W-10

A swivel, Part No. 43A1635, was attached to the free end of the riser. It acted as the connecting link between the canopy and the glider and was provided to prevent the riser from becoming twisted should the canopy tend to rotate during operation.

The pack, Part No. 44G5497, was that portion of the assembly which enclosed the canopy. It was fabricated of heavy cotton duck.

The pack was mounted on a duck-covered board. The board gave rigidity to the pack and also provided a means of attaching the assembly to the glider. Four grommets, one in each corner of the board, were provided for bolting the parachute assembly to the glider.

The rip-cord method of opening the parachute pack was utilized in this assembly. A single pin rip cord approximately 18 inches long fabricated with a small loop on the free end was used. When the assembly was attached to the glider the rip cord was attached to a cable leading to the cockpit. When operation of the parachute was desired, the pilot pulled a handle in the cockpit which actuated the afore-mentioned cable. The cable in turn pulled the rip cord, opening the pack to permit inflation of the canopy.

Bill Milanovits confirmed in a letter, dated 4 October 2002, that the initial glider deceleration parachute tests were conducted at Wright Field. However, there is evidence that following these initial flight tests, additional flight tests were conducted at Clinton County Army Air Field.

In June 1944, shortly after the D-Day landings in Normandy, France, several photographs crossed Milanovits' desk showing gliders on the ground in Normandy with deceleration chutes deployed. This was his first indication that the CG-4A deceleration parachute he had worked on had been used in combat. He was pleased that it had worked as intended. He did not think about this project again until fifty-five years later when he attended the 29th annual National WWII Glider Pilot Association Reunion in St. Louis, Missouri, in October 1999. At the reunion he talked to a number of glider pilots about his involvement in the deceleration parachute project, and was warmly welcomed by the officers and other attendees of the association. He was then deluged with questions about the project. For a few hours he relived those hectic days of World War II all over again.

The tail end of the CG-4A fuselage was originally rounded (See Exhibit "C"), but sometime during 1943 a change order was issued by Wright Field to clip the tail at a 45 degree angle to provide a flat surface on which to mount the deceleration parachute. Some of these clipped tail gliders, manufactured by the Pratt-Read Company and G & A Aircraft Company under a 1943 fiscal year contract, were assembled by members of the 26th Mobile Reclamation & Repair Squadron (Heavy) at Crookham Common in England, probably in 1944. There is also an extant photograph showing deceleration parachute hardware installed on a CG-4A there, but no parachute is evident.

The 26th assembled over 4,000 gliders at Crookham Common, but no written proof has been found to indicate that deceleration parachutes were installed on these gliders. There is some evidence that work crews on TDY from the 26th did field install deceleration chutes on previously assembled CG-4As at Bridgewater Air Field for the Normandy invasion. Bridgewater was a Ninth Air Force fighter base, 3-4 miles SE of the town of Bridgewater, England.

In a 4 May 1947 letter from former Flight Officer Henry H. Stout to David L. "Mack" McDonald, both former members of the 26th, Stout asks McDonald if he remembers the little deceleration chutes that they put on the tails of gliders.

This would further substantiate the fact that members of the 26th did install deceleration chutes on CG-4As, but most likely while on TDY at troop carrier bases, and not at Crookham Common. Stout, a glider pilot, assigned to the 26th as Technical Supply Officer, goes on to say that he flew a CG-4A on the Rhine River Crossing mission that was equipped with a deceleration chute. He recovered the parachute and sent it to his bride-to-be in New York to be made into a wedding dress.

Section II (paragraphs 4 and 5) of T.O. No. 09-40CA-1, "Pilot's Flight Operating Instructions for Army Model CG-4A Glider," dated 15 June 1944, prescribes the proper use of the deceleration parachute on CG-4As as outlined below:

Caution: The parachute will not be operated until the glider has released the towline and is in free flight. The parachute should not be opened when free flight indicated air speed is under 75 or above 140 mph.

(a) Upon approach to the landing area the parachute can be opened to attain an increased rate of descent. This is accomplished by pulling the parachute opening handle which is located in the nose section immediately to the right of the center line of the glider. The parachute control handles are equipped with a safety device to prevent the release handle being pulled before the parachute opening handle.

(b) After the parachute has been opened the copilot should be prepared for a signal from the pilot to release the parachute from the glider should such an action be necessary.

(c) When approach to the landing area is made at a low altitude and high rate of speed the parachute may be opened at glider indicated air speeds of 80 to 140 mph to reduce forward speed of the glider.

(d) When approach is made to the landing area at a high altitude the parachute may be opened at a maximum indicated air speed of 140 mph to obtain an increased rate of descent. The rate of deceleration and loss of altitude are dependent upon the velocity and attitude of the glider at the time the parachute is opened.

(e) The rate of descent as shown in Table 1 can be expected while the parachute is opened. (See Table 1).

Note: With a moderate pull up to level flying position the glider can be decelerated from 150 to 75 mph indicated air speed in 30 seconds with a loss of altitude of approximately 500 feet.

(f) Because of the higher rate of descent when the parachute is used, additional care must be taken in flaring out the glider path when making contact with the ground. In training, the parachute should be released from the glider before the tail wheel touches the ground or just before the glider comes to a stop, so that the parachute is not damaged by being dragged over the ground.

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TABLE 1

Miles per Hour Indicated Air Speed	Feet per Minute with Parachute Open
150	4200
140	3600
130	3000
120	2500
110	2000
100	1500
90	1150
80	800
	700

The above table is applicable at sea level. An addition in rate of descent of approximately 2 percent will be attained per 1000 feet above sea level.

Additionally, on Page 34 (Tail Parachute) of AAF Manual 50-17, "Pilot Training Manual for the CG-4A Glider," dated March 1945, the following data is provided for use of the deceleration parachute:

The tail parachute is an air brake used in the approach to lose altitude quickly or dissipate excess speed.

You use it:

1. To dissipate altitude without increasing speed when your landing approach is too high.
2. To reduce speed when your approach is low but too fast.

Rate of Altitude and Speed Dissipation

The rate of descent in a loaded glider is increased from a normal 400 feet per minute to between 700 and 1000 feet per minute using the tail parachute.

Higher rates of descent may be obtained in an emergency by increasing the airspeed above the range of glide speeds.

The glider can be decelerated from 120 mph to 70 mph IAS in less than 30 seconds by using the tail parachute.

How to Operate

Never release the parachute when the glider is on tow.

The maximum airspeed for release of the parachute is 140 mph.

A tugging, oscillating sensation accompanies the opening of the parachute at high speeds. This does not hamper the control, however, so don't be alarmed.

When you have released the parachute, be prepared to jettison it if the descent is too rapid and the approach short. If you have a copilot, order him to stand by to pull the release handle when necessary.

Interviews and written accounts by glider pilots and glider mechanics attest to the fact that many of the CG-4As participating in the Normandy, Holland and Rhine River Crossing missions were equipped with deceleration parachutes. Staff Sergeant Howard Johnson, the same glider mechanic mentioned on page 3, then a member of the 47th Troop Carrier Squadron, 313th Troop Carrier Group, based in Trapani/Milo, Sicily, stated that on 18 October 1943 glider pilots tested gliders equipped with the deceleration parachute, and seven days later, at least eight gliders from that unit demonstrated the use of the deceleration parachute, landing on the skids, sans the wheels. A little over three months later, on 2 February 1944, the gliders of the 47th Troop Carrier Squadron were transferred to the 62nd Troop Carrier Squadron, 314 Troop Carrier Group, in Castelvetro, Sicily. That same month the 314th was transferred to Saltby, England, in time for the Normandy invasion.

The accounts of several glider pilots who actually used the deceleration parachute in combat are delineated below:

Steven V. Painter of Oklahoma City, Oklahoma, a former WWII USAAF glider pilot, asserted at the 32nd annual National WWII Glider Pilot Association Reunion in Lubbock, Texas, in October 2002, that he flew a glider equipped with a deceleration parachute into Normandy, France, on D-Day, 6 June 1944. Painter, a member of the 78th Troop Carrier Squadron, 435th Troop Carrier Group, said that he received no training in the use of this device before this mission and was reluctant to use it until the last minute. He had the copilot deploy the parachute just as the glider brushed the tops of some small trees on his landing approach. The glider came to rest with its tail lodged in the trees and the deceleration parachute draped down behind it.

Glider pilot James L. Larkin of Haughton, Louisiana, interviewed by Charlie Day at the Lubbock reunion in October 2002, added his views about the deceleration parachute. Larkin, a member of the 84th Troop Carrier Squadron, 437th Troop Carrier Group, stated that he flew CG-4As equipped with deceleration chute on the Normandy and the Rhine River Crossing missions. He asserted that the deceleration chute on his glider was 8 feet in diameter, and worked like a charm. Larkin further declared that he had five training flights in England with the deceleration chute before the Normandy mission. He opened the parachute at cutoff, he said, used full spoilers on both missions, and in both cases the glider floated right into the landing zone.

Ed Ryan, a glider pilot in the 85th Troop Carrier Squadron, 437th Troop Carrier Group, flew the Normandy, Holland and Rhine missions. Ed stated that all of the squadron gliders on the Normandy mission were equipped with deceleration chutes. He landed in a small field surrounded by trees 50 feet or taller

in total darkness. His glider load was thirteen glider infantrymen and over a thousand pounds of land mines. As Ryan guided the glider over the tree tops he had Paul Tisdale, his copilot, release the deceleration parachute. He pulled the nose up sharply, stalling the glider. Simultaneously, the underside of the front fuselage struck the top of a power pole, snapping it. The power lines did not break and let the glider down tail first with a small jolt. Fortunately, the lines were not hot. Ryan, a retired Lt. Colonel, said in 2002, "Thank God for those chutes."

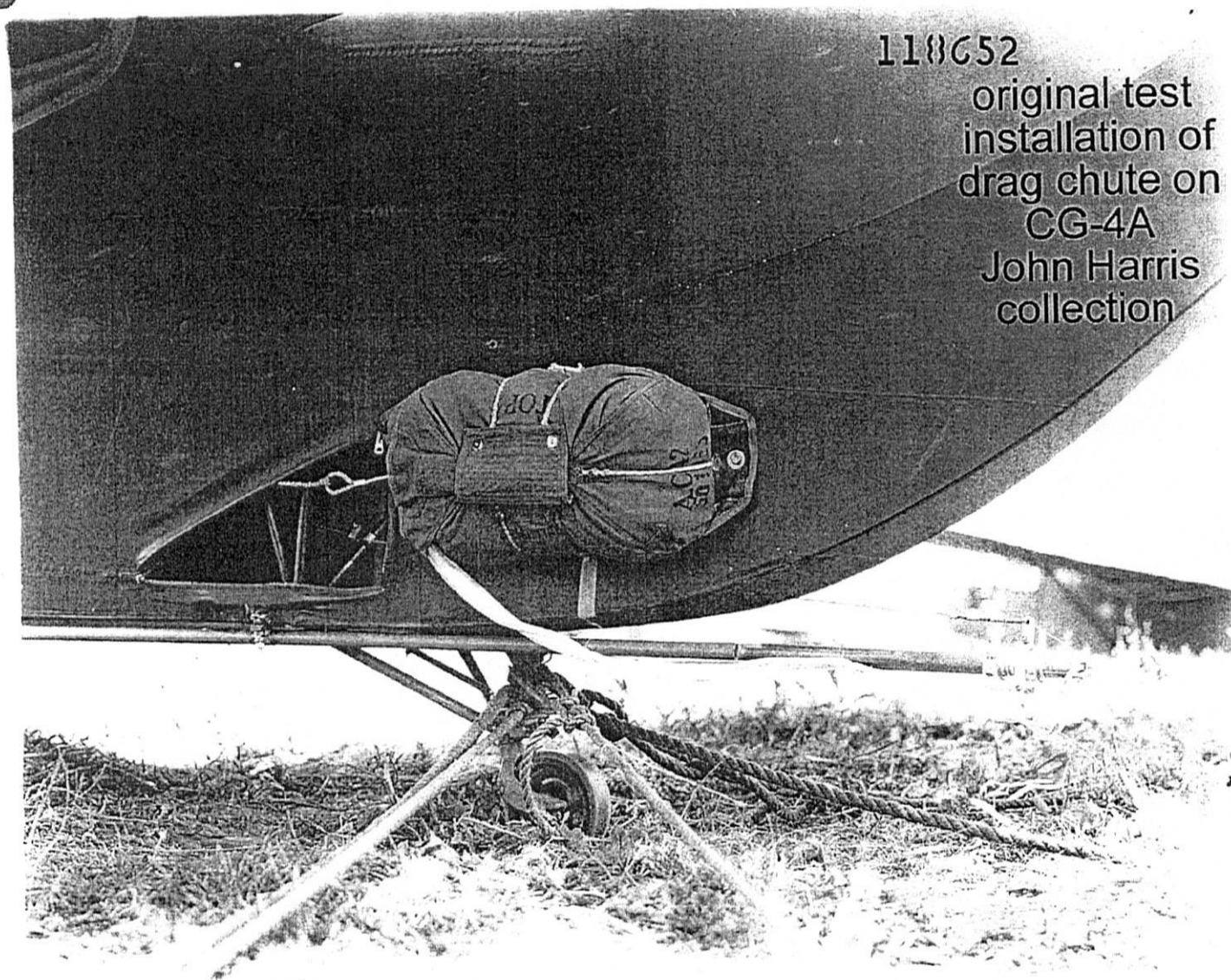
WWII Glider pilot Roger A. Krey, a member of the 81st TC Squadron, 436th TC Group, flew a CG-4A equipped with a deceleration chute into Germany on 24 March 1945 as part of Operation Varsity armada. As he prepared to land his glider on the east side of the Rhine River, near Wesel, he was startled when he saw transmission lines in front of him. He chose to dive under the wires gaining significant speed in the process. On the other side he pulled up sharply in order to land on his designated LZ in a nearby field. To curb his speed he yelled for his copilot to yank the overhead red handle which deployed the deceleration chute. Neither the pilot nor copilot could see the chute as it blossomed behind the glider, but they felt the glider slow appreciably. Just before touchdown the copilot pulled the yellow handle releasing the parachute. The glider skimmed along the ground for a short distance before coming to a stop. The parachute had worked perfectly.

The effectiveness of the CG-4A deceleration parachute received mixed reviews. Former Glider pilots Jim Larkin, Ed Ryan and Roger Krey thought it was great, while glider pilots Sam Mitchell and William D. Knickerbocker said that it was not a good device, that the side-slip was the way to go. Knickerbocker, the author of *Those Damned Glider Pilots*, said that the first drag chute he saw was in Gela, Sicily where he watched an exhibition with a CG-4A landing on skids. That night, he noted in his diary: ".... none of it looked very practical to me, for the skids gave you no steering control and the parachute was attached to the weakest part of the glider." Several days later he wrote in his diary that "we were going to have trouble with those landing 'chutes.'" Just a few hours later his group suffered several crack ups because of the drag chutes. Four gliders were totally wrecked, but no one was injured. The next day he released his drag chute during a flight at just over one hundred miles per hour and touched down at one hundred ten miles per hour into a thirty mile per hour head wind. As noted above, to Bill, the drag chute was ineffectual, and he preferred side-slipping to lose altitude. He said it was quicker and safer.

In the final analysis, the deceleration parachute obviously performed the task it was designed for. The idea had considerable merit, and very probably prevented the injury or death of many glider pilots and their passengers. Those responsible for this device can be proud of their handiwork.

Note: Charles L. Day of Lambertville, Michigan, is the author of *Silent Ones, WWII Invasion Glider Test & Experiment*, published in 2001. He has done considerable research on World War II military gliders. Former WWII glider pilot Leon B. Spencer of Prattville, Alabama, a retired USAF Major and author of the *History of the 26th Mobile Reclamation & Repair Squadron (Heavy)*, is also a mil-

tary glider historian. The 26th M.R. and R. Squadron, based at Crookham Common, England, assembled most of the CG-4As used in the Normandy, Southern France, Holland, Battle of the Bulge and the Rhine River Crossing missions. William Thomas "Bill" Milanovits of Harlingen, Texas, provided much of the information in this document. Bill graduated from Washington University in 1942 with a Bachelor of Science degree in Mechanical Engineering. He worked as a civilian engineer in the Parachute and Clothing Laboratory, Equipment Branch, at Wright Field during and after WWII. Former Captain Marion "Smokey" Miller of Indianapolis, Indiana, an engineer, was assigned to the nucleus of the Glider Branch at Wright Field during World War II. During the 1946-47 period Smokey Miller, Floyd Sweet and Lew Stowe were the nucleus of the Glider Branch. Other data for this research paper was taken from T. O. 09-40AC-36, T. O. 09-40CA-1 or supplied by Charles L. Day, Marion "Smokey" Miller or Leon B. Spencer. This paper was compiled by Leon B. Spencer and Charles L. Day in April 2003. It was revised and expanded in December 2003.



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original test
installation of
drag chute on
CG-4A
John Harris
collection

EXHIBIT "A"

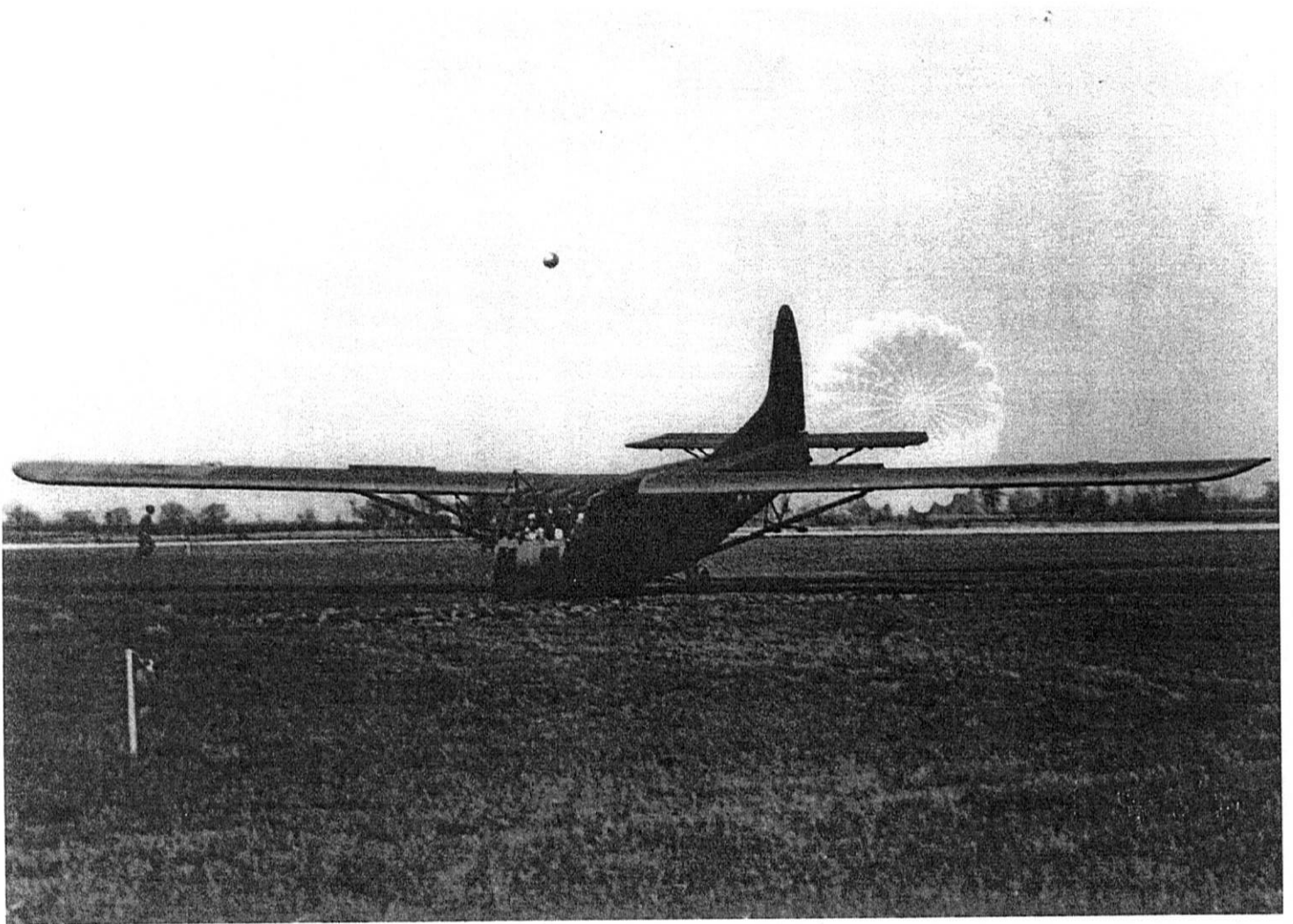


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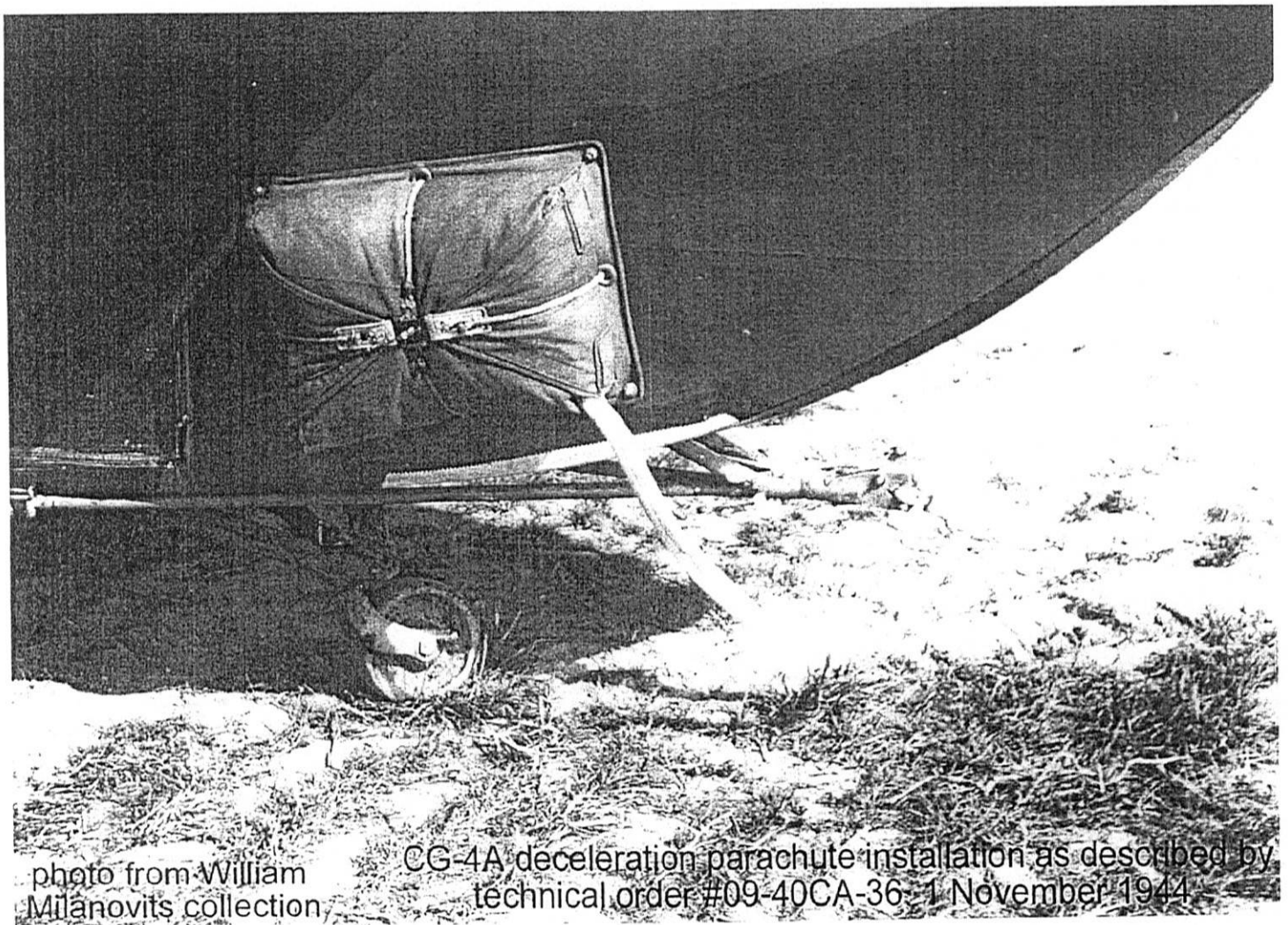


EXHIBIT "C"

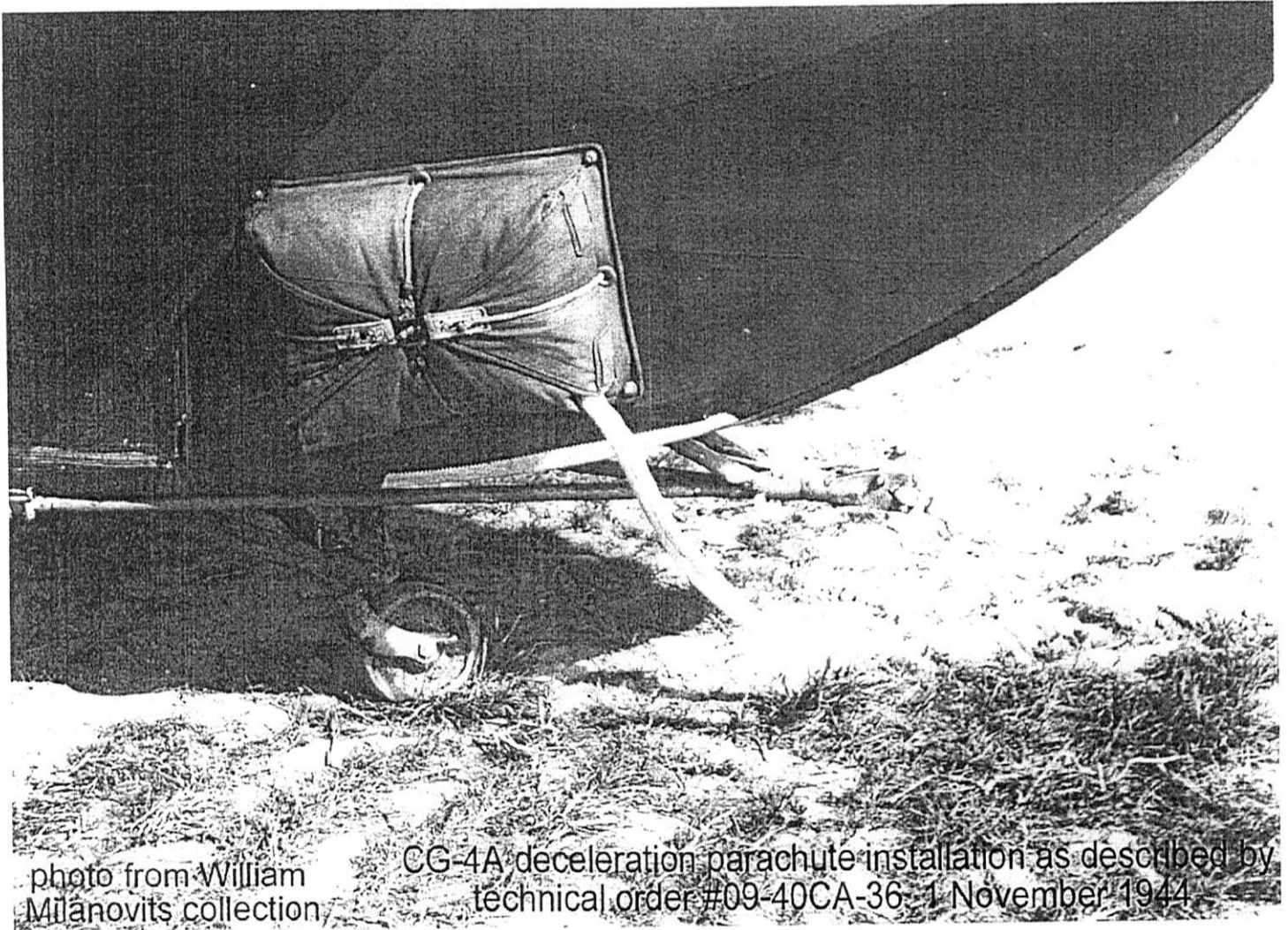
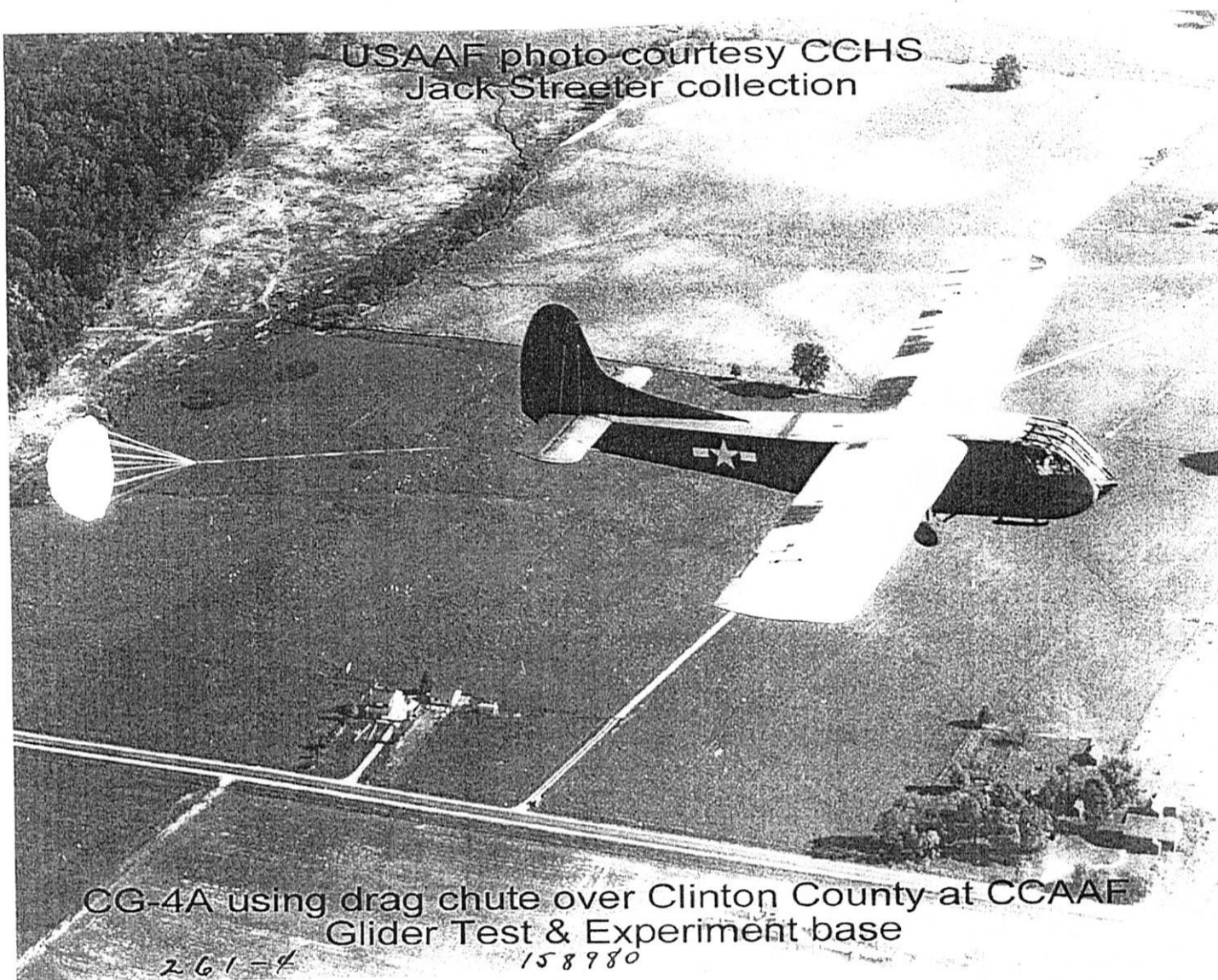


photo from William
Milanovits collection

CG-4A deceleration parachute installation as described by
technical order #09-40CA-36-1 November 1944

EXHIBIT "C"

USAAF photo courtesy CCHS
Jack Streeter collection



CG-4A using drag chute over Clinton County at CCAAF
Glider Test & Experiment base

EXHIBIT "D"

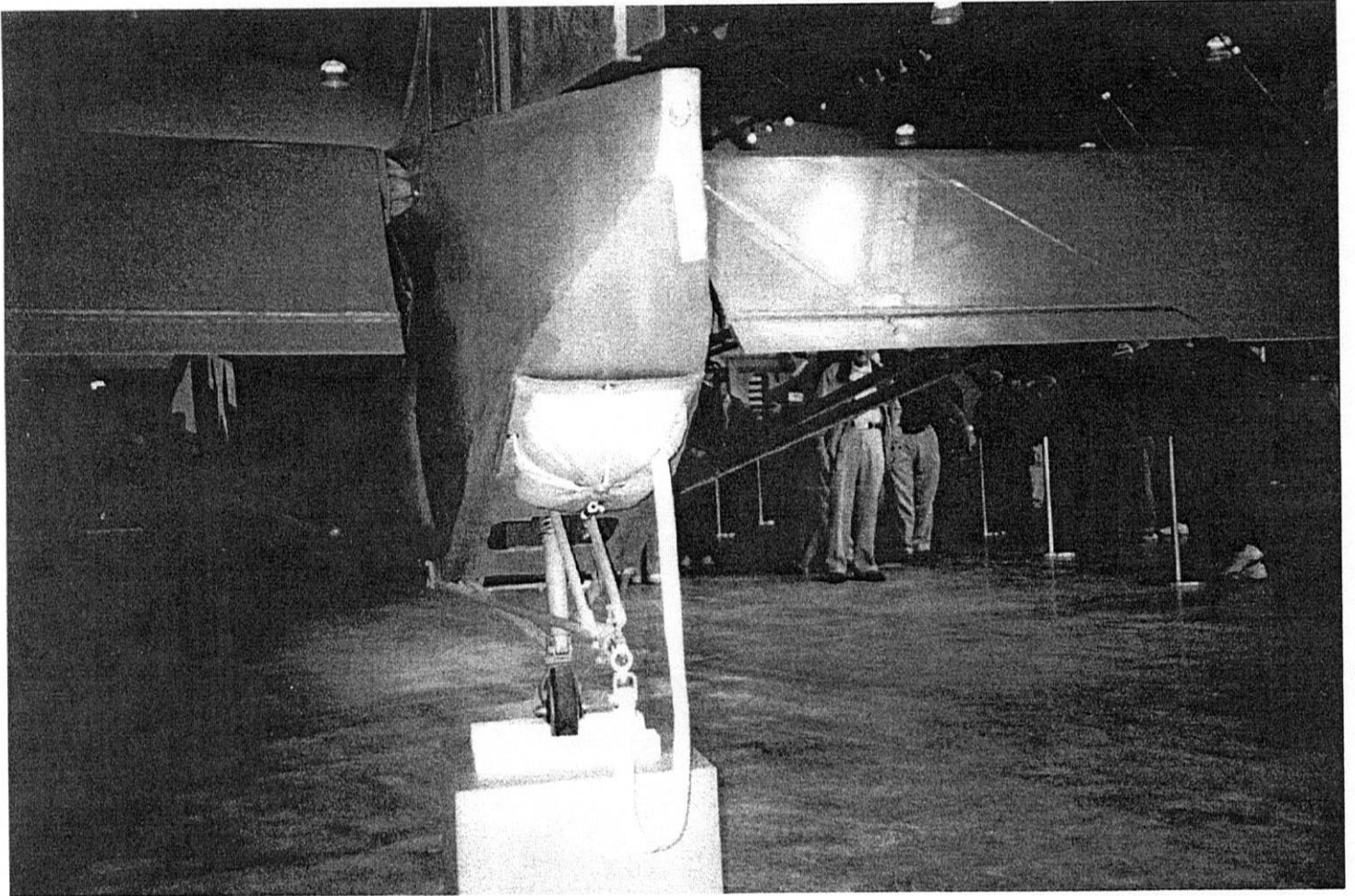


EXHIBIT "E"