# C-3 Link Trainer

Flight simulation in the C-3 Link Trainer, U.S. Army Air Forces, 1940s. A cadet takes the controls, and a nearby instructor relays commands by telephone.

The link trainer pictured is a 1942 Model C-3

The term Link Trainer, also known as the "blue box," is commonly used to refer to a series of flight simulators produced between the early 1930s and early 1950s by Edwin Albert Link, based on technology he pioneered in 1929 at his family's

business in Binghamton, New York.

The original Link Trainer was created in 1929 out of the need for a safe way to teach new pilots how to fly by instruments, using a radio range for determining an airplane's position in instrument flight conditions and a subsequent let-down to a field for landing. This primary navigation system was comprised of sparsely located Adcock low-frequency range transmitters. Each facility consisted of four legs which could be used as "beams" for navigating either to or from a station on the airways or for shooting low approaches for landing. Each range station emitted audio signals comprised of four quadrants. Two quadrants provided a Morse Code signal of "N" (dash-dot) while the opposing quadrant emitted an "A" signal (dot-dash). Each quadrant overlapped precisely to provide a three-degree leg or beam by meshing the two audio signals to provide a continuous dash or "on course" monotone signal.

These simulators became famous during World War II, when they were used as a key pilot training aid by almost every combatant nation. More than 500,000 US pilots were trained on Link simulators, as were pilots of nations as diverse as Australia, Canada, Germany, Great Britain, Israel, Japan and the USSR.

The Link Flight Trainer has been designated as A Historic Mechanical Engineering Landmark by the American Society of Mechanical Engineers.

The Link was mounted on a base which permitted the trainer to turn, tilt and bounce as the instructor (who sat at a desk outside the trainer) created rough air and put the pilot through simulated instrument flight conditions. An operator sat at the desk and transmitted radio signals which the "pilot" in the link heard though his ear phones. The pilot "flew" the link through various turns, climbs, and descents, and the link's "course" was traced in red ink by the remote "bug" on a map on the table. After a flight was completed, the pilot could study the red-line course to determine what he might have done incorrectly. There was no AIR CONDITIONING in these trainers... and on a hot west Texas day, it got pretty hot inside this 'box'. Many a young trainee almost crashed and burned--not from lack of flying skills, but from the heat!

In the late 20's Edwin A. Link learned to fly while working for his father in Binghamton, New York who manufactured organs and pianos. Because of the economic depression at that time,

flying lessons became too costly. Link got the idea to shorten the expensive flying lessons by learning rudimentary piloting skills using a ground aviation trainer. Drawing from his expertise in air-driven pianos and pipe organs, Link used organ parts and compressed air to build the first flight simulator.

In 1928, Edwin A. Link left his father's organ building business to begin work on a "pilot trainer." He designed the trainer using suction through fabric bellows to cause motion. Organ bellows and a motor provided the means for the trainer, mounted on a pedestal, to pitch, roll, dive and climb as the student "flew" it. In 1931 he received a patent on his "pilot maker" training device.

Most of his first sales were to amusement parks. In the beginning there was very little interest by the flying community in Link's trainer. Initially the trainer was meant for instruction of visual flight, but in 1934, after a series of tragic accidents while flying the air mail, the Army Air Corps bought six Link trainers to assist in training pilots to fly at night and in bad weather, relying on instruments. The second customer for the Link trainer was the Japanese Imperial Navy in 1935. Many Japanese pilots were trained in these Link trainers and used their skill and knowledge in fighting the American planes in World War II.

The need for pilots with instrument training in World War II

resulted, by the end of the war, in Link delivering 6,271 Link trainers to the Army and 1045 to the Navy. The Link trainers were also used by 35 foreign countries. Although Army Air Force's aviation cadets flew various trainer aircraft, virtually all took blind-flying instruction in the Link.

Movement of the trainer is accomplished by vacuum operated bellows, controlled by valves connected to the control wheel (or stick) and rudder pedals. An instructor sat at the desk and transmitted radio messages which the student in the Link heard through his earphones. Inside the "cockpit", the student relied on his instruments to "fly" the Link through various maneuvers while his navigational "course" was traced on a map on the desk by the three-wheeled "crab". Slip stream simulators gave the controls the feeling of air passing over control surfaces, and a rough air generator added additional realism during the "flight".

The Link Trainer holds a significant place in aviation history. It was the first true flight simulator, and provided safe instrument training to hundreds of thousands of student pilots during the 1930s and 40s.