

The DC-3 Aviation Museum

presents:

The Legacy OF THE DC-3

by:

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Profit From Passengers:

Basically this is the story of an unforgettable airplane and some practical thinking men from American Airlines whose penetrating insight played a key role in its inception. To fully understand the impact this machine had on aviation requires a bit of insight into the prevailing economics and politics of the era that literally necessitated its birth. For that, let's begin with the great depression of the thirties. That was a time when the prosperity of the '20s appeared to collapse overnight. It was a time when the United States' GNP plummeted from \$103.1 billion in 1929 to \$58 billion by 1932. It was a time when unemployment jumped from 3.2 percent of the work force to a whopping 23.6. It was a time when the average annual wage went from \$1,356 to \$754, and a time when money for new investment plunged from \$7.8 billion a year to a mere \$100 million.

Of considerable interest is that in spite of the country's severe economic woes, the airlines initially bucked the trend. Within the first three years, while other industries were laying people off, the air carrier work force grew by an amazing 254 percent. From virtually nothing in 1929, passenger miles flown jumped to over 85 million in 1930, and to more than 127 million by 1932. During this period the number of passengers flown tripled.

But to put this in perspective we need to understand that even in the banner year of 1932, fewer than half a million passengers were flown; air travel continued to be the domain of the affluent - those of them that were left. This makes it more important to note that revenues earned from carrying mail doubled, and that mail was most definitely the airlines' main source of profit. Since this revenue was supplied by the Post Office - which, thanks to Congress, then had generous funds to disperse - those carriers with good mail contracts felt there was reason to remain optimistic in spite of an ailing economy.

Yet even as early as 1932 there were ominous signs. With airmail running up large deficits

for the Post Office, postage had to be raised from 5¢ to 8¢ - an obvious threat to volume. Shortly thereafter, Roosevelt's arrival in office produced a host of economic programs that began to pinch the industry. In late '33 the Postmaster General announced a 28 percent cut in airmail rates due to "budgetary exigencies." Additional government action began driving labor costs upward. These things began marking a point where carrying airmail ceased being the bonanza it had once been, and the year 1933 became the last in which mail revenue exceeded that derived from passenger service.

The next blow came out of a political scandal. It focused on former president Hoover's Postmaster General for an infamous "spoils conference" associated with certain route awards. By late January of '34 things had reached a point where President Roosevelt was being urged to cancel all domestic airmail contracts. By February 7, those urgings turned to strong recommendations. On February 9, after being assured that the Army Air Corps could take over the airmail with no interruption of service, the Postmaster General announced the annulment of 40 domestic route certificates held by nine carriers effective at midnight on February 19th. Roosevelt supported this annulment with the reasoning that the airlines were beneficiaries of a corrupt system, and as such, "could not be allowed to profit from it."

But the Army's pilots proved to be unprepared for the task. Inexperienced in the unique skills it required, they suffered a series of fatal crashes. This had the effect of pressuring the administration to establish a new airmail bidding process to get the commercial carriers back into the picture, and to do it in a way that effectively put to rest the scandals of the past.

To accomplish this, lawmakers began drafting an "Act" which, among other things, would set forth conditions regarding what would qualify a carrier as an airmail bidder. Before Congress could lock these conditions into language acceptable to its members, the Army had another crash. With pressure mounting, Roosevelt knew he couldn't wait for Congress to act, and had his Postmaster General put together an interim plan. On March 30, 1934 the Post Office Department advertised for bids on 90-day temporary contracts. In lieu of the above "Act", their advertisement simply excluded those previous holders of air mail contracts "cancelled for fraud or collusion," without specifically prohibiting them from purging their "tainted" aspects through reorganization and restructuring. Thus their experience could be returned to the scene, but their organizations would come back as fundamentally new entities. This was when American Airways reorganized to emerge as American Airlines, a pattern similarly followed by the many other major carriers of the time.

Most carriers went about bidding overly low in a scramble to get what they desired, with

many carriers winning routes on the basis of bids submitted at levels that barely reflected the actual cost of carrying mail. This was a bidding strategy based on a belief that these short term contracts - being awarded at maximum rates that were unreasonably low - would soon have to be extended with an inevitable upward adjustment in airmail rates.

The belief was not well founded. When Congress finally promulgated the expected legislation in the form of the Black-McKellar Act, the 90-day contracts were extended for only a year. Rates, the Act decreed, would henceforth be fixed by the ICC, but it also prohibited the Commission from revising them upward. For the present, airmail carriers were locked into the low bids they had made to get their route contracts. In lieu of any government help, they began seeing the best long term solution to their money woes as an intensified effort to expand passenger traffic.

The major problem in this regard was that a concentration on passenger service imposed a far different set of operational demands. While the equipment and technology essential to satisfying these demands was finally coming forth, its availability was limited. And that which was available still left room for improvement. In reality, the industry couldn't afford to relax its pressure on the government to legislate some form of economic relief.

The relief finally came in August of 1935, with benefits that were truly debatable. Congress passed legislation that did authorize the ICC to revise air mail rates upward, but this raised intense objections from the Post Office Department - which hinted strongly at cutting airmail schedules as a way to resist having another branch of government raise the rates it had to pay for services. As frustrating and threatening as all that was, the above-mentioned legislation delivered further disappointment by imposing limitations on efforts to focus on passenger traffic by prohibiting mail-carriers from establishing passenger or express service "which in any way competes with passenger or express service available upon another airmail route . . ." But if it prevented one carrier from "poaching" passenger traffic from another, this legislation did not preclude that carrier from bidding into new mail routes to capture new passenger markets. So now, since winning a new route virtually meant winning an exclusive passenger market, airmail carriers continued the low bidding practices with much less concern about hauling mail below cost. The airline environment had unquestionably reached the point where an efficient airplane was an absolute must in making the passenger chase profitable.

Actually, the first airplane to come close to this description had been on the drawing boards as early as 1932 in the form of Boeing's B-247. Looked upon as "the first modern airliner," the B-247 was an all metal, low-wing aircraft to be powered by two 550-hp engines. It would be capable of cruising at 155 mph with a passenger capacity of ten. It's been said that, had a planning decision not been made at an early design stage to reduce

the plane's size, its passenger load might have been far more profitable. However, at the time it went into production, the more critical consideration was that United Airlines was the lead customer with locks on the first 60 deliveries. Because this threatened to shut out the competition for at least two years, the other major carriers needed desperately to influence another airframe manufacturer to work up a competitive design.

TWA submitted specs to Douglas that ultimately led to their DC-1 design. Liking what they saw, on September 20, 1932, TWA signed a contract for the production of one prototype. In just under ten months this airplane made its maiden flight - a less than auspicious beginning that nearly ended tragically because of carburetor difficulties. As these and other bugs were worked out, the airplane began looking better and better. The prototype was soon pressed into making various demonstration flights, the most famous of which was a two-stop coast-to-coast trip made in a record-setting 13 hours and 2 minutes with Jack Frye of TWA and Eddie Rickenbacker of EAL at the controls. Ironically, this trip was flown on February 19, 1934, carrying one of the last loads of mail on the final day of the just-cancelled airmail contracts. As disappointing as that day might otherwise have been, it was at least brightened by a promise of good things to come.

When the DC-1 entered production later in 1934, enough refinements and structural changes had been incorporated into the design to justify a new model number: the DC-2. By this time it had been upgraded from a 12 to a 14 passenger aircraft. It would be powered by two 710-hp engines and be capable of cruising at 190 mph. American's engineers saw it as a good airplane, but noted numerous shortcomings. Its landing gear had no down-latches, giving them a tendency to collapse during taxi - and sometimes even while at rest. Its manually operated hydraulic system was slow, and could pull the First Officer out of emergency situations when he became occupied with "pumping" demands. Initial experiences during winter operation indicated a need to add ice protection to the rudder counterbalance. There were also other technical details that included matters of lighting, carburetor heat and door placement that our experts marked for modification before we could commit to an order. Beyond these shortcomings were the larger ones involving an aircraft that American's engineers felt was still somewhat underpowered and too small to carry a proper payload. Except for the two latter complaints, Douglas accommodated our desires by making all other modifications - including moving the passenger loading door from the left to the right side of the aircraft, to standardize our ramp operations. The power and payload complaints would later become the focus of American's aircraft experts during efforts that eventually spawned the DC-3.

One of our initial experiences with the DC-2 demonstrated an additional shortcoming, that being the discovery that it needed increased vertical fin area. This came about on a blustery day in Chicago, when American's Chief Engineering Test Pilot, M.G. "Dan" Beard,

was checking out a line Captain. The final exercise in their program was a go-around with the left engine idling. At about 500 feet, extremely rough air was encountered at a time when Beard's attention was distracted by a rising cylinder head temperature on the right engine. Sensing a force throwing him to the right, he looked up and found the nose high and turning to the left. He then glanced down to see the Captain's foot pushing fully forward on the left rudder pedal. His panel scan spotted an airspeed reading of about 72 mph. Recognizing that the airplane was going into a flat spin, Beard recalled that during flight testing one DC-2 lost 5,000 feet in a similar situation before control was regained. He shouted for rudder trim while he slammed throttles wide open, shoved the nose down, and pushed in full right rudder. Though Beard knew full throttle would produce excessive manifold pressure at their low altitude, he also knew that nothing less would produce the airspeed needed to overcome their predicament: a fin stall. Fortunately, the airplane staggered out of its stall, and it was later discovered that this condition consistently occurred right at 72 mph. American's engineers held immediate discussions with engineers at Douglas that resulted in a fin extension of sufficient area to lower the fin's stall speed by 4 mph. All DC-2s received by American were so modified.

There are numerous variations of the story on how the DC-3 was conceived. But basically it's the story of a need, the timely arrival of an engine to help in filling the need, the vision and know-how of American's engineering experts, and the persistence of a legendary airline executive. Supposedly it started in the summer of 1934 when C. R. Smith, newly appointed as AA's President, and Bill Littlewood, his Vice President of Engineering, were boarding an airplane in Dallas enroute from company headquarters (then in Chicago) to Los Angeles. The airplane was a Curtiss Condor, a twin-engine bi-plane American Airlines was then using to provide one-of-a-kind sleeper service on this route. Mindful of the DC-2's performance superiority over the Condor, "C.R." is presumed to have said, "Bill, what we need is a DC-2 sleeper plane!" Upon returning to Chicago, Littlewood and his chief aid, Otto Kirchner, went to work laying out specifications. The initial intention was to establish only those changes that would allow the basic DC-2 to accommodate sleeping berths. As things progressed, they saw that widening the fuselage by 26" would provide room for 14 berths. The widened fuselage was also lengthened by two and a half feet. As time and further changes passed, the design demanded additional wing area plus a larger horizontal stabilizer and fin. An 850-hp engine that had then become available was exactly what was needed to make it all work. But when commonality with other DC-2 components dropped from a reasonably acceptable 85 percent to less than 10 percent, Douglas showed increasing reluctance to build it. The airplane was looking less and less like a stretched DC-2, . . . and far more like a new model: a DC-3.

Barely able to keep up with their backlog of 150 DC-2 orders, Douglas simply wasn't interested in committing any resources to build only a small number of highly specialized

airplanes for one customer. After all, no other carriers were using sleeper planes. Besides that, they doubted American's ability to raise the money to pay for them. And beyond that, Douglas knew it had a good airplane in the DC-2. On the other hand, C. R. Smith believed his engineers had developed spec's for an even better airplane. He was so convinced, in fact, that in mid-December of 1934 he focused his intense powers of persuasion on Donald Douglas in a two hour, \$335.50 phone call. The outcome was that Douglas agreed to build the airplane and American agreed to purchase the first 20, with the first 10 to be sleeper transports and the next 10 to be day-planes. One of "C.R.'s" best arguments was that as a day-plane the enlarged fuselage could accommodate up to 21 passenger seats. That, he predicted, would greatly expand the market for this basic airplane. And history truly supports the accuracy of this prediction.

The first prototype rolled out in December of 1935, only one year after the famous phone call. It was introduced as the DST, for Douglas Sleeper Transport, with the day-plane models to be designated as the DC-3. But this was an airplane that would ultimately become so widely recognized that the DC-3 designation became almost a generic description for all models in the series.

On December 17, the first "DST/DC-3" took to the skies. At the end of the third of its brief initial flights - between which only minor adjustments were needed - the airplane was turned over to AA's Captain Dan Beard and a Douglas test pilot for flight testing. The initial phases of this program progressed without major hitches until take-off performance tests were begun. At a specified gross weight of 24,000 lbs. the aircraft was targeted to take off within 1,000 feet. In all initial attempts it overshot the mark by 25 to 50 feet. The powerplant in use was a Wright GR-1820-G2 "Cyclone," rated to deliver 1,000-hp during take-off. Its performance during these tests so puzzled Wright's engineers that they asked to have the aircraft for a few days "to make certain adjustments." Three days later tests were resumed with engines performing noticeably better, and take-offs were easily made at distances of 970 feet. Wright's engineers had found that at take-off rpm, lubricating oil churning in the power section created a parasitic drag which absorbed some 75-hp. Installing some internal baffles eliminated the problem and further enhanced the flow of oil to the engine's scavenge pumps.

Another "modern" innovation also enhanced the DC-3's performance. While the DC-2 had been operating with a two-position propeller, by the time the "-3" program was underway, Hamilton Standard had entered the process of flight testing an innovative constant speed prop. Recognizing it as a significant improvement over its two-position predecessor, Bill Littlewood saw to its use on the DC-3, the first such commercial installation of this new technology.

As the DC-3 reached the final phases of testing, Captain Beard began putting it through a series of instrument approaches. While doing this, he noticed that as the airplane was flown into a skid, its nose pitched down to a degree proportional to the amount of skid. In analyzing this undesirable characteristic with Douglas' chief aerodynamics engineer, it was found that the problem related to a cross-flow ahead of the vertical stabilizer which spoiled depression forces on the lee side of the horizontal fin. The correction for this resulted in the DC-3's characteristic dorsal fin forward of the base of the vertical fin.

As flight testing reached the point of landing at maximum landing weights, Captain Beard began suspecting that the DC-3 had insufficient braking capacity. The brake manufacturer's response was to increase brake pressure, which they did by a considerable amount. On the first test using boosted pressure, the Douglas pilot was making the landing while Beard took pictures of runway markings from the cockpit window. Just after touchdown, he felt himself thrown against the window as the aircraft entered a left turn that headed it toward a hangar only 200 feet off the runway. The other pilot shouted "Brakes!" and gunned the left engine to stop the turn. But Beard saw that the airplane was in an unstoppable ground loop. Batting his partner's hand off the throttles, he instead gunned the right engine to complete the loop. The aircraft tore through a chain link fence, slid sideways about 50 feet and came to rest with its tail about two feet from the hangar. An inspection revealed that the increased brake pressure had blown out the right wheel brake actuating cylinder. The end result was the installation of an improved high-pressure brake system.

In April of 1936 American received its first DST delivery - still with an "X" license - and began using it on proving flights. By May 21, the airplane received Certification. And on June 25, 1936 - just a little over 55 years ago - C. R. Smith, Bill Littlewood, Dan Beard, Otto Kirschner and a host of other very proud members of the American Airlines family saw history made as our Flagship Illinois inaugurated DC-3 service between Chicago and Newark. It is most important to emphasize that this wasn't just American Airlines' history: it was aviation history; it was economic history; it was even world history. It was also a glimpse of the future.

Before long, the DC-3 was clearly proving to the skeptics that the airlines really could be freed from their dependency on government mail pay. No one knew better than C.R.

Smith that it was truly "the first airplane that could make money just by hauling passengers." As it rendered the DC-2 obsolete, mounting orders saw Douglas convert its production capacity completely to the DC-3. When it quickly showed its direct operating costs to be nearly 50% lower than the B-247, even United Airlines put in an order. By 1937, revenue from airline passenger traffic had so exceeded that from airmail that the old system whereby routes and schedules were set up to meet the needs of the Post Office was abandoned in favor of meeting the growing demands of the traveling public.

The legacy of the DC-3 had truly begun.

It's fair to say that the success of the DC-3 established a very strong rapport between American and Douglas. It was, to be sure, an airplane that contributed enormously to positioning each corporation as a leading force in commercial aviation. Records show that Douglas built 609 DC-3s to fill civilian orders, and 10,046 for the military. An additional 3,400 were built under licenses in Japan and Russia. With more than 14,000 DC-3-type aircraft having been put into service around the globe, it became, without a doubt, the world's most ubiquitous aircraft; and it may still be among the most widely recognized.

At the height of the DC-3's popularity American Airlines owned 94 of these airplanes. At one time we flew them exclusively. When WWII broke out, the U.S. military drafted 47 of our aircraft. Fifteen of them were taken from our line fleet, the other 32 were modified to meet military specifications before they left the Douglas assembly line. These aircraft were variously designated as C-49Es, C-49Hs, C-50s and C-50As. Most C-49Es were fitted as ambulances. At least two of the "Hs" served with the RAF. The "50s" were sent to Australia and operated under civilian call signs. The "50As" became 28-passenger troop carriers. As might be expected, some were casualties, others returned to AA after the war or went on to other roles and identities - some even winding up with competitors. American retired its last DC-3 in March of 1949.

As noted, the vast majority of DC-3-types were built for the military. This airplane handled a seemingly infinite variety of roles and operated successfully in environments far outside of anything its designers could have envisioned. It performed masterfully with incredible diversity, towing gliders, dropping paratroops, moving people, supporting them, protecting them, sustaining them -- and bringing them home when they were suffering. It did these things through three wars -- and more!

Not only did this airplane contribute in very large measure to our industry, it played a significant role in the preservation of world freedom. It was an illustrious airplane that became a legend and a lasting tribute to those whose efforts helped bring it into existence.

***This article was written several years ago for "The Flight Deck,"
American Airlines' publication for its professional cockpit crewmembers.***

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