

Boeing Model 377 Stratocruiser Propeller Woes

by Carl Kuhns

Introduction

The Boeing Model 377 Stratocruiser was Boeing's entry into the post-World War II commercial transport market. Powered by four Pratt & Whitney R-4360s, the first flight of a Stratocruiser was in July 1947. It entered airline service with Pan American World Airways (P.A.W.A.) within the year, flying passengers in pressurized comfort between San Francisco, California and Honolulu, Hawaii. The production run of Stratocruiser was short in both time frame and number with only 56 Stratocruisers built from 1947 to the end of production in 1950. P.A.W.A. was the largest purchaser of Stratocruisers, paying \$24 million for 20 aircraft. The airlines had a choice of two propellers to equip their Stratocruisers. The Hamilton Standard was the overwhelming choice over the Curtiss Electric propeller.

The Curtiss Electric propeller for the Boeing 377 had hollow steel blades. The weight of its hub and blades was 864 pounds. This was 100 pounds more than an equivalent Hamilton Standard assembly. The Curtiss Electric propellers had a complex electrical actuating mechanism consisting of slip rings, brushes, gear trains, solenoids, propeller brake mechanisms, and electrical wiring. This complexity, along with 400-pound per airplane disadvantage, compared to the Hamilton Standard hydraulic propeller, must have been a big factor in the airline's choice of propellers.

Like preceding Hamilton Standard props, the Stratocruiser propeller was controlled hydraulically with engine oil pressure boosted by the propeller governor to set the blade pitch via a piston and cylindrical cam in the hub. The cam rotated a master gear which meshed with segment gears on the bases with four hollow steel blades. The blade shell cavities were filled with a black rubber filler material to help deaden vibration of the blade skins.

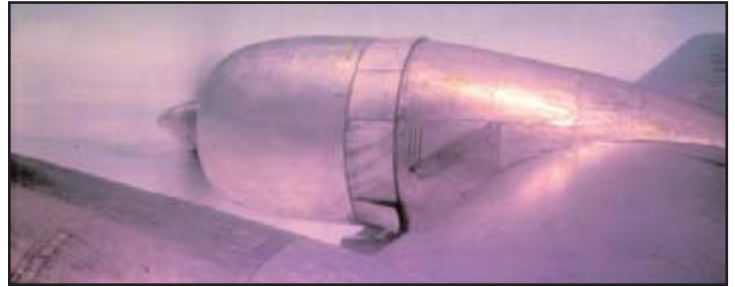
The propeller hub model designation was 24260 and the blades were referred to as 2J17F3 or 2J17H3. The propeller hub and four blades weighted 761 pounds and had a diameter of 17 feet. Hollow steel propeller blades gave trouble almost from the beginning of Stratocruiser Airline Service.

This article details a few incidents and accidents caused by hollow steel blades and the effort to keep them airworthy.

Incidents and Accidents

The start of the Stratocruiser propeller blade difficulties began on January 24, 1950 when a P.A.W.A. Stratocruiser en route to Tokyo, Japan lost the No. 4 engine from its wing. In spite of substantial damage the aircraft landed safely. A day later a Northwest Airlines Stratocruiser had its No. 1 engine depart the wing. After an emergency landing at Chicago the Northwest Aircraft was found to have a small piece of its number one propeller blade lodged in the men's room. Both incidents were caused by an in-flight propeller imbalance.

A third incident occurred on March 29, 1951 when a



P.A.W.A. Stratocruiser on approach to landing at Idlewild Airport in New York City had to have its No. 1 propeller feathered when a severe vibration was felt. Once the aircraft landed, it was found that 12.5 inches of a propeller blade was missing and the No. 1 nacelle was drooping.

The situation turned more serious on April 29, 1952. On that date a P.A.W.A. Stratocruiser N1039U crashed in dense Brazilian jungle with no survivors. Although the main wreckage was located, No. 2 engine and propeller were never found. Examination of the remaining pieces of No. 2 engine's mount showed its failure was due to application of forces beyond which it was designed. The cause of the engine separation was probably an unbalanced propeller.

Tragedy struck again on December 6, 1953, when yet another P.A.W.A. Stratocruiser, N90947 out of Honolulu, had No. 4 engine and propeller depart the wing the wing halfway en route to Wake Island. After some control difficulties, the flight crew flew to the closest land, Johnson Island and landed safely. The accident board determined that it was a propeller blade failure that caused the wrenching of No. 4 engine and propeller from the wing.

A P.A.W.A. Stratocruiser N1032U lost its No. 3 engine and propeller on March 26, 1955, off the coast of Oregon. The pilot could not maintain control of the aircraft, and he ditched it in the Pacific Ocean. Of the 23 occupants onboard, there were 4 fatalities. Again, the cause of the engine and propeller separation was found to be failure of the propeller blades of No. 3 propeller.

Corrective Actions

Within a couple of weeks of the January 1950 Stratocruiser blade failures, the Civil Aeronautics Administration (CAA) ordered close inspections of Model 2J17 propeller blades. A tapping test of the blades was intended to detect fissures in the filler material of the shell cavities. The CAA also ordered a magnetic inspection for cracks when the aircraft made its first stop at its main base. Any blades with cracks or large filler fissures had to be removed from service.

As noted in the Brazilian accident report of 06/26/53:

"...with less than two years of service experience, longitudinal cracks were found in a number of blades in the outboard blade portions, about four inches from the leading or trailing

edge and parallel to the edge. These cracks were found to be due to the black rubber filler in the blade breaking and allowing the steel shell of the blade to vibrate locally from aerodynamic buffeting. At this point the blade design was again altered by using nylon-rubber filler instead of black rubber, the nylon filler being tougher and more resistant to shattering. A daily tap test, required as an interim measure, to locate any internal voids that were occurring in the blades with the black rubber filler"[1].

Another modification was the introduction of a nickel-plated hollow steel blade for Boeing 377 aircraft in early 1954. The CAA certified this blade, manufactured by Hamilton Standard, for air carrier operations on September 14, 1953. This blade was a bit heavier than the unplated one because of the plating. Hamilton Standard hoped that the plated blade would be less subject to damage from foreign objects picked up by the propellers.

The CAA made installation of propeller blade imbalance detectors mandatory as of July 30, 1955 on Boeing 377 aircraft. The detectors enabled the flight engineer to identify which engine or propeller was malfunctioning and to shut down the engine and feather the propeller.

The C.A.B. administrator stated the final cure for the problematic hollow steel blades in a letter dated June 28, 1955:

"As a result of this investigation, and of the investigations conducted following six other accidents or serious incidents, we have concluded that, in the interest of safety, the Hamilton Standard Model 24260 propellers having 2J17 series hollow steel blades presently used on Boeing B-377 aircraft should be removed from service and replaced with propellers having solid metal blades. This shall be done at the earliest possible date consistent with the ability of the propeller manufacturer to supply satisfactory blades."[2].

The final governmental action in the hollow steel-bladed Boeing 377 Stratocruiser was an issuance of an airworthiness directive in the fall of 1958.

Airworthiness Directive

AD 58-19-02 HAMILTON STANDARD: Applies to All Hamilton Standard 2J17 Hollow Steel Propeller Blades installed on Boeing 377 Aircraft.

Compliance required as indicated.

Operators that are using or have used these blades learned through adverse experiences that exceptional maintenance procedures and repair techniques are required to assure the continued airworthiness of these blades. In order to preclude the possibility of additional adverse experiences occurring either under the supervision of the present operators or other operators who will acquire some of the involved aircraft, the following shall apply:

1. Not later than August 1, 1959, remove from service all 2J17 Series propeller blades.
2. Prior to August 1, 1959, no operator who has not had previous experience in the overhaul and maintenance of 2J17 Series propeller blades shall be issued a certificate of airworthiness for aircraft on which these blades are installed[3].

A Personal Note

I was motivated to research and write about the Stratocruiser propellers for two reasons. First, I enjoy learning about old airplanes and aircraft engines. Also, I have a personal involvement with P.A.W.A. Stratocruisers.

In 1955 as a small child, I traveled with my parents to Hawaii. Both westbound and eastbound flights were on P.A.W.A. Stratocruisers. I have two photographs of the aircraft that took us to Hawaii and returned us to California. We traveled westward to Honolulu on P.A.W.A. N90944 Clipper *Romance of the Skies*. Two years later this same Stratocruiser crashed in the Pacific Ocean en route to Hawaii of unknown causes. All aboard perished. We returned to California on Stratocruiser N90945. A photo taken on the ramp in Honolulu prior to departure shows a ladder in front of No. 1 propeller. I assume the purpose of the ladder was to facilitate the mandatory preflight inspection of the hollow steel bladed propeller blades.

Notes

1. CAA Accident Investigation Report Pan American World Airways Boeing 377 N1032U near Carolina, Brazil April 29, 1952
2. CAA Accident investigation report Pan American World Airways Boeing 377 N032V off the coast of Oregon March 1, 1955 accident report released November 15, 1955
3. Airworthiness Directive 58-19-02

Sources

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<http://www.boeing.com/history/boeing/m377.html>
Hamilton Standard Service Bulletins Numbers 177, 193, 273, 302
Type Certificate Data Sheet No. P-870, 242 Series Hubs, Hamilton Standard Division of United Aircraft Corporation
Type Certificate Data Sheet No. P-826, C644S Hubs, Curtiss-Wright Corporation, Curtiss Division
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