Sikorsky Archives News

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United Aircraft Corporate, Pratt & Whitney Canada, and Sikorsky Aircraft Collaborated in the Past to Conquer Land, Sea and Air

Turbo Train

Assault Support Patrol Boat (ASPB)

ABC

S-58T

During the lean production years of the mid 1960s to the mid 1970s, Sikorsky and corporate entities developed the Turbo Train, the Assault Support Patrol Boat, the S-58T and the Advancing Blade Concept (ABC) Helicopters. All of these systems were powered by specific versions of the Canadian Pratt & Whitney PT-6 shaft turbine engines.

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The TurboTrain was conceived by United Aircraft Corporate Systems, and was developed by the Surface Transportation Systems of Sikorsky Aircraft. In January 1966, United Aircraft was awarded a contract by the U.S. Department of Transportation for two three-car TurboTrains to operate between Boston and New York. Shortly thereafter, Canadian National Railways signed a contract for five seven-car trains to operate between Montreal and Toronto. The trains could be operated in tandem sets of 14 cars with a total capacity of 600 passengers.

The basic design philosophy of the Turbo Train was to produce a light weight system with aerodynamic body lines to achieve 160 miles per hour. Two light weight Canadian Pratt & Whitney ST-6 shaft turbine engines located in the Power Dome Car per Figure (1) provide the power to the drive system. Single axle truck installations result in low track friction. Improved passenger ride comfort was achieved by supporting the cars from above through a pendulum structure shown in Figure (2). This arrangement causes the car body to bank inward on curves like an airplane. Separate spring devices were provided for vertical and lateral forces. The center of gravity of the cars as shown in Figure (3), is lower than conventional railroad cars. This further improved the passenger ride comfort. This system produced a speed advantage to operate on curves at speeds up to 40% greater than that possible with conventional trains.

Amtrak TurboTrain

Canadian National TurboTrain

ST-6 Turbine Engine

Figure 1-Power Dome Car Model

TURBOTRAIN MAIN FEATURES

- -Passenger carrying Power Dome Cars on each end
- -Light weight turbine engines
- -2-1/2 feet lower than conventional cars
- -Lower center of gravity
- -Pendulous suspension system
- -Guided single axle wheel trucks
- -Banks inboard around curves
- -40% greater speeds around turns
- -All cars have room for 50 passengers
- -Increased passenger comfort
- -Fastest and smoothest train at the time
- -Potential speeds up to 170 mph depending on condition of tracks

Amtrak TurboTrain showing Power Dome Cars at each end

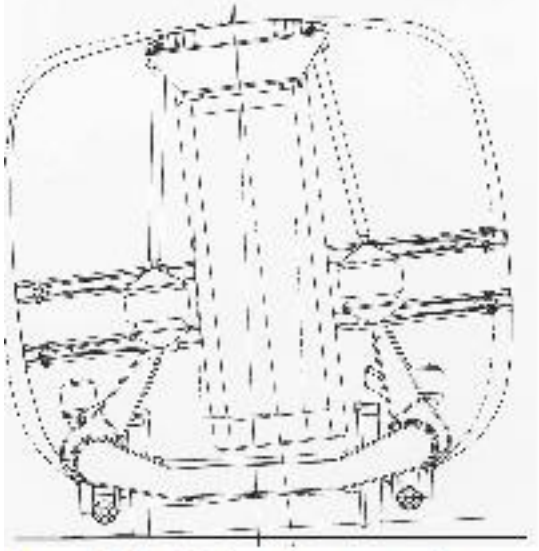
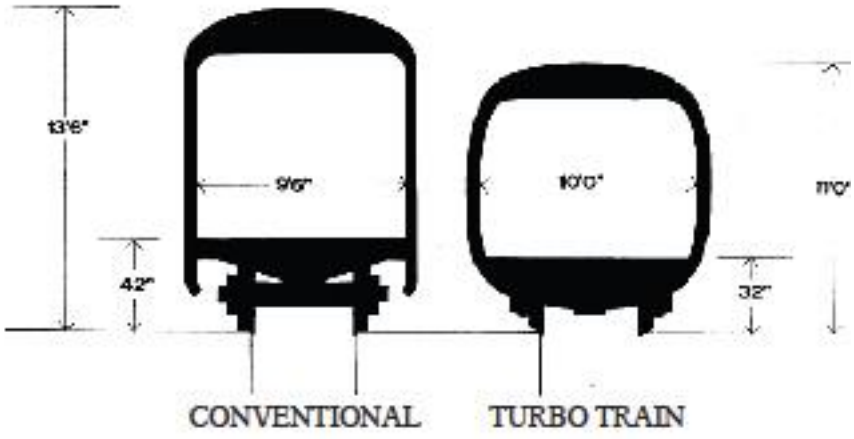


Figure 2- Pendulous Suspension System & Single Axle Truck Installation



COMPARATIVE DIMENSIONS
Figure 3

The Canadians called the TurboTrain the Rocket Train. It was unquestionably the most technically advanced high speed train for the period while it was used in both United States and Canada. In 1974 the United States Department of Transportation and Amtrak were evaluating a French train company against the United Aircraft and Sikorsky team for procurement of additional trains to be used in the Chicago corridor. Negotiations fell apart and UAC/Sikorsky Aircraft decided not to bid. The Sikorsky decision was to end its association with the train efforts for business reasons. Sikorsky Aircraft's surprised decision to end its TurboTrain operations drew sharp congressional criticism, and zeroed in on the delays and "foot-dragging" by Amtrak and DOT in the turbine powered train decision. Senator Abraham Ribicoff, charged that DOT and Amtrak had "derailed" Sikorsky's effort to get into the train business. Thus ended the 10 year TurboTrain program.

The sea venture with United Aircraft, Pratt & Whitney Canada and Sikorsky Aircraft started in the mid 1960s when marine gas turbine engines were under development for high speed boats.

A Thunderbird hull was designed and built by Alliance Machine Company. United Aircraft Corporate Systems provided the technology for installation of twin ST-6 gas turbine engines. The Thunderbird design goal was to package speed, endurance and reliability into a marine system capable of winning an open ocean race against the world's top performance competitors. The 172 mile Sam Griffith Memorial Race on February 22, 1966 provided this opportunity. Waves averaged 8 to 10 feet and visibility was poor between Miami and Bimini. Of 31 boats starting only two finished. Thunderbird crossed the finish line after 4 hours, 48 minutes, as the winner averaging 36 mph in the roughest seas ever encountered in this race. The only remaining competitor finished 2-1/2 hours later.

Thunderbird in action

In 1967 Sikorsky Aircraft Surface Transportation Systems won a U.S. Navy contract to develop a high speed Assault Support Patrol Boat. The ASPB was designed, developed and delivered to the U.S. Navy with the following specifications:

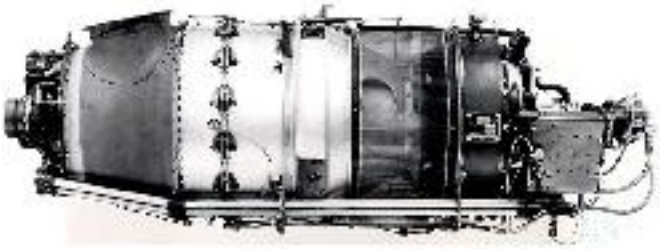
-3 Canadian Pratt & Whitney ST-6 turbine engines
-Speeds up to 50 miles per hour
-Maneuver in water depth of 4 feet
-105 millimeter howitzer
-3 water jet pump propulsion systems
-Bar grill armor mounted 3 to 4 feet away from hull
-small machine gun in bow
-20 millimeter automatic cannons

ASPB Starboard side view

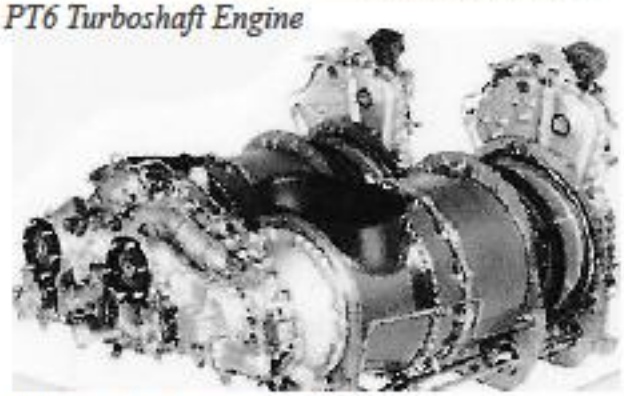
ASPB port side view

The air venture with Pratt & Whitney Canada and Sikorsky Aircraft started in 1969 when S-58 commercial helicopter operators requested that the radial piston engine be replaced with a modern turboshaft engine to improve and extend the useful life of the aircraft. After a technical evaluation of the engines available that met the power, configuration cost and reliability requirements, the Pratt & Whitney Canada PT6T Twin Pac turboshaft engine was selected. A small "Skunk Works Team" was organized and given the full authority of Sikorsky to design, build test, develop, and certify the aircraft.

The Twin Pac turboshaft engine was unique providing more than sufficient power required with the additional feature of dual engine reliability. The Twin Pac was a configuration of two PT6 engines connected to a combining gearbox with a single horizontal output drive shaft. The original piston engine was mounted with its output shaft center line on an angle. This required Sikorsky to design an angle gearbox with an output drive shaft on the same angular center line as the original S-58 aircraft's piston engine. The engine installation requirements of structural mounting, controls, fuel, lubrication, instrumentation, accessories, fire protection, inlet and exhaust systems were designed and manufactured as conversion kits to be installed at Sikorsky or at the customer's facilities. First flight was in 1971 and FAA certification occurred approximately one year later.



PT6 Turboshaft Engine



PT6T Twin Pac Turboshaft Engine

S-58T

HSS-1 (S-58) Engine Compartment

S-58T Engine Compartment

Military surplus HSS-1, H-34 and commercial S-58 aircraft have been converted with the PT6T Twin Pac engines and are operating around the world today. The S-58 was launched in 1952 and the basic aircraft has been in worldwide service for over 58 years, This impressive record is a testament to the Sikorsky helicopter technology of that era. The Pratt & Whitney Canada PT6 family of turboshaft engines has a similar impressive record of utilization in the aerospace, maritime and industrial industries.

The Air Venture with Pratt & Whitney Canada and Sikorsky Aircraft continued into the 1970s with the introduction of the Advancing Blade Concept (ABC) helicopter. Sikorsky Aircraft won a contract with the U.S. Army for the development of a high speed helicopter utilizing the ABC concept. An essential part of developing the ABC as a high speed helicopter required an engine that was fully developed and reliable while producing the power required. The PT6T-3 Twin-Pac was the engine selected to drive the two counter rotating rotors. Auxiliary propulsion was provided by two Pratt & Whitney J60-P3A engines, each mounted on opposite sides of the fuselage.

The aircraft design, fabrication, test and development culminated in a first flight approximately two weeks after the S-58T first flight. An extensive flight test program was initiated with various aircraft configurations. The development and flight test programs continued to 1981 achieving maximum speeds of 276 mph in level flight, and 302 mph in a shallow dive. The combination of the air vehicle and the PT6T Twin-Pac engine proved the ABC concept and demonstrated the technology required for a future high speed helicopter.

ABC Test Aircraft with auxiliary propulsion

ABC Test Aircraft without auxiliary propulsion

1970s Futuristic Artist Conception of ABC

Current X2 with a Light Helicopter Turbine Engine Company (LHTEC) T800 turboshaft engine

The Air Venture with Pratt & Whitney Canada and Sikorsky Aircraft continued with the S-76B and S-76D™ helicopters. The search for the optimum engine for the Sikorsky S-76 helicopter started during the initial design stage in the mid 1970s. The engine selected for the S-76A was the Allison Model 250-C30, rated at 650 SHP for Take-Off at Sea Level Standard Day conditions. Maximum Take-Off gross weight for the aircraft is 10,500 pounds. Aircraft basic weight empty is 6,306 pounds.

The S-76B design was initiated to improve the utility of the aircraft at higher gross weights at high altitude hot day conditions. Pratt & Whitney Canada PT-6B-36A turboshaft engines were selected. The engine was rated at 981 SHP for Take-Off at Sea Level Standard Day conditions. Maximum Take-Off gross weight for the aircraft is 11,700 pounds. Aircraft basic weight empty is 7,623 pounds.

The S-76C design incorporated a lightweight turboshaft engine with lower fuel consumption providing improved payload characteristics. The Turbomeca Arriel 1S1 turboshaft engines were selected. The engine was rated at 725 SHP for Take-Off at Sea Level Standard Day conditions. Maximum Take-Off gross weight for the aircraft is 11,700 pounds. Aircraft basic weight empty is 7,181 pounds.


S-76D™


S-76A


S-76B


S-76C

The S-76D™ aircraft is the newest Sikorsky with the most advanced technology in intermediate size helicopters. These technology improvements include:

- Pratt & Whitney Canada PW210S engines
- Full Authority Digital Electronic Control (FADEC)
- All composite flaw tolerant main rotor blades
- Advanced Thales avionic system and autopilot
- Dual speed rotor with active vibration control
- Quiet mode for enhanced public acceptance
- Optional Rotor Ice Protection System (RIPS)
- Increased useful load and extended range performance

We would like to thank our readers for the following historical corrections to recent newsletter issues:

- *October, 2009 issue: Alan Mrock was the original builder of the S-38 model. It was damaged in handling during public displays, and was subsequently repaired by Bill Wargo.*
- *January, 2010 issue: During the transitional period of archival responsibility from the Corporate Office to the Divisions, and establishment of the Sikorsky Historical Archives as a non profit organization, Phil Spalla was the first director of the archives, followed by Harry Hleva.*

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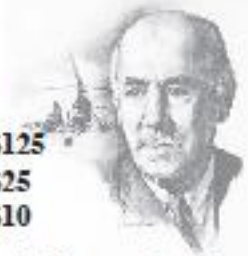

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Designed and edited by
Lee Jacobson and archive members

There was always the comforting realization that nearly all discoveries were preceded by numerous failures.

Igor I. Sikorsky

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