

Over the years, Waco 10s have been fitted with many different engines. The original configuration is shown with the 90-hp Curtiss OX-5.



The Waco 10

Taperwing genesis

BY PETER M. BOWERS

The most popular American airplane for sports, training and business flying between 1927 and 1929 was a very ordinary-looking, three-seat, open-cockpit biplane, the Waco 10. The 10, which indicated the design's place in a product line started by the Weaver Aircraft Company, soon was dropped in favor of a variety of number and letter designations that identified the many variations of the basic model.

The Weaver Aircraft Company was formed in the winter of 1919-1920 as the result of an informal gathering of four aviation-minded individuals in a hangar in Lorain, Ohio. The company was named for George E. (Buck) Weaver but was identified by the acronym WACO, pronounced wah-co as distinct from the Texas city of way-co. However, the name was not widely recognized as an acronym because of the practice of referring to airplane companies by less than their full names and because written references generally only capitalized the W as though it was a proper name.

The original company never had proper production facilities and built only half a dozen airplanes, some after a change of quarters to Medina, Ohio.

Following one more move, this time to Troy, Ohio, in 1923, the company found a permanent home and reorganized as the Advance Aircraft Corporation. The products were still called Wacos, however. And after the aircrafts' success, the company's name was changed in June 1929 to Waco Aircraft Company to be better identified with its

product. And, just so there was no confusion as to the location of the factory even after several years of operation, the Waco 10 nameplates stated that the airplanes were built in Troy, Ohio, "NOT New York!"

The three-seat Model 10 that appeared early in 1927 was a simple state-of-the-art refinement of the very successful Model 9. A new engineer, Edward E. Green, used the same basic construction of steel-tube fuselage and tail framework with wood frame wings, all fabric covered. The fuselage had more refined lines, and there was a new shape to the tail. A really major change was made in the landing gear—it was a divided design, favored by the competition, instead of the old straight axle as on the Model 9. The Waco gear differed from its competition by having the shock absorber strut connected to the top longerons. No brakes were fitted to the main wheels at the time, although brakes became an option later.

The original Waco 10 was equivalent in size, weight and price to the bottom-of-the-line models of its main competitors—Swallow, Travel Air, Eaglerock and American Eagle—in being powered with the cheap (and then plentiful) 90-hp war-surplus Curtiss OX-5 engine, a heavy water-cooled V-8. Despite the availability of modern engines, the low price of war-surplus units remained attractive for quite a few years, and the OX-5 powered model was Waco's bestseller into 1930, when the supply of OX-5 engines fi-

nally was exhausted. Later called the 90 because of its 90-hp engine and then the GXE, the Waco 10 received Approved Type Certificate (ATC) A-13 on October 6, 1927. By 1928, because of detail refinements, the price increased from \$2,385 to \$2,460.

For some reason, the Model 10 used the same radiator position as the Model 9: under the center section of the upper wing, where the airplane's occupants were sure to get a scalding shower in case of not-infrequent leaks. This seemed to be the 10's only regressive feature; the competitors all placed their radiators under the nose.

The competitors were ahead of Waco in another respect; in addition to their basic OX-5 models, they also were upgrading airframes with more powerful engines to reach a broader market. Waco was quick to follow and inaugurated a large number of variations of the basic Waco 10 airframe.

The increases in power came quickly, the first change being to the 125-hp German Siemens Halske SH-12, an air-cooled radial engine that was marketed in the United States by T. Claude Ryan. This model had many advantages of later designs—more power, less weight and air-cooling. Surprisingly, it cost only a little more than the GXE; price of the Siemens-powered Waco, which was marketed as the Siemens-Waco 125 and later as the Waco 125 (it never did receive a letter designation), was only \$2,970 in early 1928. ATC A-26 was awarded on February 8, 1928.

The rugged Waco 10 airframe could take

continued

even more power without being beefed up, and three units were fitted with 220-hp Wright J-5 "Whirlwind" engines for participation in the 1927 Ford Reliability Tour, where they placed fifth, seventh and ninth. And the following year a Whirlwind-Waco won the Ford Tour. But more power was not necessary to win a race. One OX-5 powered Waco 10 won its class in the New York-to-Spokane, Washington, cross-country race held in conjunction with the 1927 National Air Races. The 2,352 miles were covered in 30 hours 23 minutes of flight time. There were many such inter-city events that private pilots could enter with their own airplanes in those days, but they often were competing with factory pilots flying customized models as was the case with the New York to Spokane event.

The 220-hp Whirlwind-Waco was identified originally as the 220 and the Sport 220 and received ATC A-41 on June 18, 1928. By then, Waco had changed its designation system and the model had become the ASO. The A identified the engine, the Wright J-5; the S stood for straight wing as distinguished from the optional tapered wing, identified by the letter T; and O identified the particular fuselage design. Price from the factory in 1928 was \$7,215, and by early 1929, it was \$7,335.

For those who wanted more power at surplus prices, there were Wacos equipped with the 150-hp Wright A and the similar 180-hp Wright E. These were the American-built versions of the famous French Hispano-Suiza engines, popularly called "Hisso's" in the United States. Both were used in the Waco DSO model, which received ATC A-42 on June 18, 1928. Price was \$3,935 for the A-powered model and \$4,085 for the E.

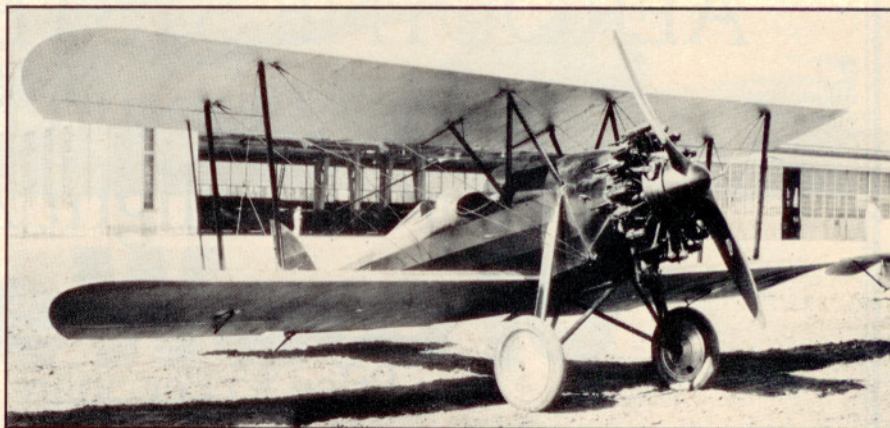
Subsequent designations resulting from engine changes are too numerous to detail separately in the text but are presented in a table (see p. 96). Not all of the engines tested in Waco 10s resulted in new letter designations, and not all were used on production models that received ATCs. Some configurations simply were tested and then rejected as being unsuitable. Among these was a unit powered by the widely publicized Fairchild Caminez of 1927, a four-cylinder radial that drove a very slow-turning four-blade propeller.

The other design changes that affected the aircraft's letter designations—the wings and fuselage—were not as numerous as the engine changes.

There was only one major wing change: a set of tapered wings that were interchangeable with the straight wings. Tried experimentally in 1927 on an OX-5 powered model and called the 10-T, the low-power model did not allow the new wings to demonstrate their full potential (their decreased area resulted in a higher wing loading). So the wings were tried again on a J-5 model. The results were sensational, and the 220 Sport Taperwing, or ATO, became the leading American air show aerobatic airplane.



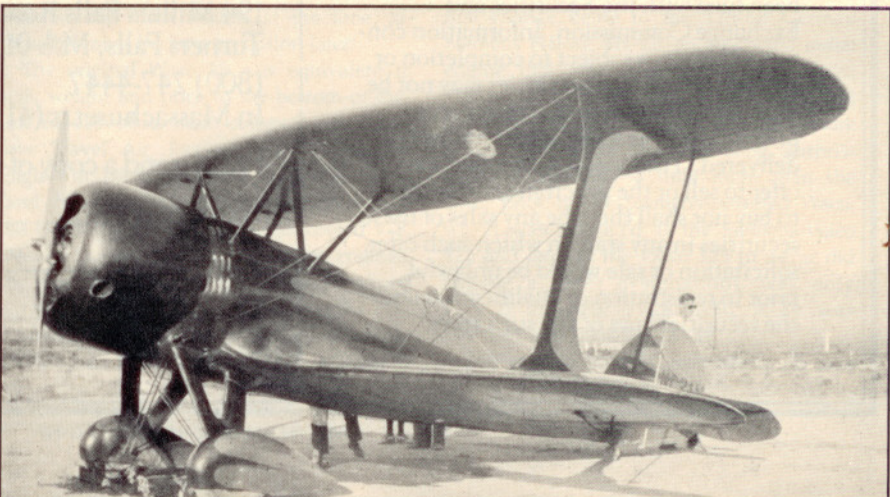
The first re-engined version of the Waco 10 on the market was the 1928 Model 125, powered with the 125-hp Ryan-Siemens SH-12 air-cooled radial engine imported from Germany.



Three Waco 10s were equipped with 220-hp Wright J-5 Whirlwinds for the 1927 Ford Reliability Tour. One is shown above. This modification went on the market in 1928 as the Model ASO.



A popular engine change was the 115-hp Milwaukee-Tank air-cooled rebuild of the OX-5. This was called the GEX Special (above). A CTO Taperwing (below), cleaned up for racing, has the 240-hp Wright J-6-7 engine, low-drag landing gear and I-struts replacing the parallel struts.



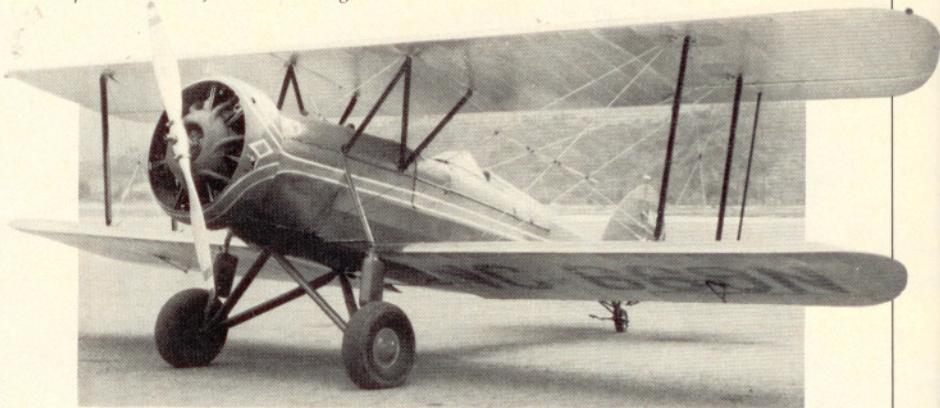
Some are still used for this purpose today.

What was it about the big three-place Waco Taperwing that gave it such good aerobatic capability in competition with much lighter designs? The secret was in the tapered wings. Designed to be interchangeable with the straight wings, they had the same chord and spar spacing at the root. Since the same flat center section was used, the gap between the upper and lower wings also was the same. But because the chord decreased from the root toward the tip while the gap remained the same, the ratio of the gap to the chord was much higher than on the straight wings. Aerodynamically, this put the outer portions of the wings much farther apart and greatly increased their efficiency. Sixty-three taperwings were sold under ATC A-123 (issued to the ATO on March 15, 1929) and A-257 (issued to the CTO on October 16, 1929), very good business for what were essentially custom models selling for \$8,525 each.

The 225- to 240-hp J-6-7 "Whirlwind" engine used in the CTO was Wright's 1929 replacement for the discontinued 220-hp J-5 and was one of a family of basic 165- to 300-hp engines with interchangeable major parts. The 165-hp J-6-5 had five cylinders and got the letter B in Waco's system; the model became the BSO (previously BS-165). The J-6-7 had seven cylinders and got the letter C, as CSO and CTO, while the nine-cylinder J-6-9 got the letter J.

Fuselage changes also were few. Most of the 10-series retained the O design, but there were two variations. Northwest Air-

The only PSO Model built was powered with a 140-hp A.E.C. (later Jacobs) LA-1 engine.

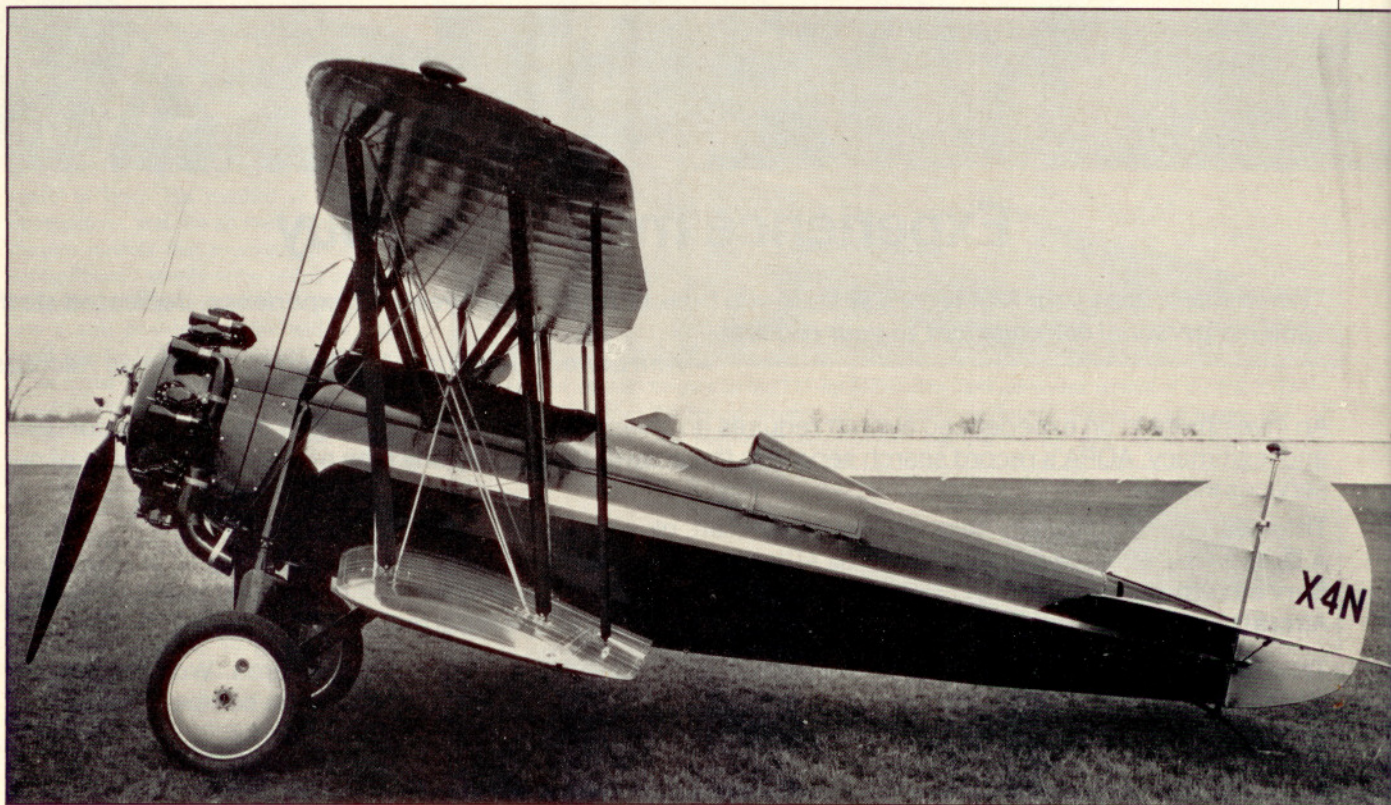


lines bought four JYM models as single-seat mailplanes with 330-hp J-6-9s and slightly modified tapered wings. The fuselages were lengthened 14 inches and had a mail compartment in place of the front cockpit. A similarly lengthened model, but with a standard front cockpit and modified straight wings, was the JWM. As special-purpose models, neither of these qualified for a full ATC but the JYM got a lesser Category 2 approval. While the change of all three letters indicated that the J-planes were entirely different models, they still had enough interchangeable parts with the other 10s to be included in that family.

Some state-of-the-art changes were incor-

porated after different models were in production but did not affect the designations in spite of obvious appearance changes. One example is the revised landing gear that replaced the long shock strut from the axle to the top longeron with a two-section strut that was angled and stabilized by a steel tube outrigger opposite the lower longerons. Besides the optional wheel brakes, less noticeable changes ranged from round stranded wires for interplane bracing in 1927 to streamlined steel tie-rods on some models in 1928.

One change that was made after GXE production ended was the installation of an air-cooled rebuild of the OX-5, called the



Built in 1929 as a taperwing with the 225-hp Packard diesel, the aircraft above was first designated Model HTO and flown as a test model on an Experimental license. In 1930, now fitted with straight wings and the same engine, the only HTO became Model HSO and received an Unlimited license.



When the Packard engine of the HSO was replaced with the 220-hp Wright J-5 in the early 1930s, it became the ASO, shown above. In 1948 a change to a 220-hp Continental R-670 made it an ASO Special.

Designation	Engine/Hp	ATC or Memo Approval	Date	Number Built*	Remarks
10, 90, GXE	Curtiss OX-5/90	13	10-6-27	—	\$2,460 (1927) \$2,385 (1928) \$3,145 (1929)
125	Ryan-Siemens/125	26	2-8-28	31	\$5,300
220, ASO	Wright J-5/220	41	6-18-28	—	\$7,215 (1928) \$7,335 (1929)
DSO	Hisso A/150	42	6-18-28	—	\$3,935 (A)
	Hisso E/180				\$4,085 (B)
Sport Taperwing, ATO	Wright J-5/220	123	3-15-29	—	\$8,525
BS-165, BSO	Wright J-6-5/165	168	6-25-29	29-plus	\$6,370
CSO	Wright J-6-7/225	240	9-30-29	17-plus	\$7,335
CTO	Wright J-6-7/225	257	10-16-29	—	\$8,525
HSO	Packard Diesel/225	333	6-27-30	1	\$7,500
QSO	Continental A.70/165	337	7-14-30	1	\$5,575
PSO	A.C.E. LA-1/140 (Jacobs)	339	7-17-30	1	\$5,175
220 Special	Wright J-5/220	2-101	7-16-29	—	2,310 lb gross weight
ASO	Wright J-5/220	2-102	7-30-29	2	Seaplane conversion
DSO	Hisso A/150	2-245	7-30-30	1	Seaplane conversion
BSO	Wright J-6-5/165	2-262	8-20-30	1	Seaplane conversion
JYM	Wright J-6-9/330	2-361	6-27-31	4	Mailplane
GXE Special	Milwaukee-Tank V-502/115	2-363	7-8-31	—	Post-sale engine change

*Quantities taken from U.S. civil registration records do not reflect exports and fractional company records. —, not obtained.

	WACO 10			
	10/90/GXE (1927)	220/ASO (1928)	BS-165/BSO (1929)	CTO (1929)
	Specifications			
Powerplant	Curtiss OX-5 90 hp @ 1,400 rpm	Wright J-5 220 hp @ 1,800 rpm	Wright J-6-5 165 hp @ 2,000 rpm	Wright J-6-7 240 hp @ 2,000 rpm
Wingspan (upper)	30 ft 7 in	30 ft 7 in	30 ft 7 in	30 ft 3 in
Wingspan (lower)	29 ft 5 in	29 ft 5 in	29 ft 3 in	26 ft 3 in
Length	23 ft 6 in	22 ft 6 in	23 ft 6 in	22 ft 6 in
Wing area	288 sq ft	288 sq ft	288 sq ft	227 sq ft
Empty weight	1,200 lb	1,550 lb	1,677 lb	1,529 lb
Gross weight	2,025 lb	2,600 lb	2,485 lb	2,600 lb
Wing loading	7.03 lb/sq ft	9.02 lb/sq ft	8.62 lb/sq ft	11.45 lb/sq ft
Power loading	22.50 lb/hp	11.80 lb/hp	15.06 lb/hp	11.55 lb/hp
	Performance			
High speed	97 mph	125 mph	120 mph	137 mph
Cruising speed	84 mph	105 mph	100 mph	115 mph
Landing speed	37 mph	44 mph	44 mph	52 mph
Initial climb	520 fpm	1,050 fpm	750 fpm	1,200 fpm
Service ceiling	12,000 ft	19,000 ft	18,000 ft	19,000 ft
Range (fuel quantity)	385 sm (37 gals)	575 sm (65 gals)	600 sm (65 gals)	575 sm (65 gals)

Milwaukee-Tank V-502. The initial installation of this 115-hp engine received Memo Approval 2-363 on July 8, 1931, and the unit was called the GXE Special. Some of these Tank-Waco conversions were flying after World War II, well before the antique airplane boom got underway in the 1950s.

Other changes were made by owners after their airplanes had been in service for a while, most notably the addition of Townsend anti-drag rings around radial engines and the substitution of fat Goodyear Airwheels for the original high-pressure tires on wire wheels. Some pilots who used their airplanes for racing adopted lighter and lower-drag landing gear, while others used single I-struts on tapered wings.

As an example of the changes made during factory testing and subsequent ownership, look at one airplane registered variously as X4N, NR4N, NC4N, and plain N4N before getting still other numbers. It was built in 1929 as a taperwing with the new 225-hp Packard diesel engine. Designated HTO, it first flew on an Experimental (X) license but later was upgraded to Restricted (NR). Then it was fitted with straight wings as the HSO and received ATC A-333 in June 1930, thereby getting an Unlimited (NC) license. It was used for two years by the Packard Motor Company as one of the official airplanes in the Ford Reliability Tours. A subsequent owner replaced the Packard engine with a Wright J-5 and the one-only HSO became an ASO.

In 1948, the unit's engine was changed to a World War II surplus 220-hp Continental R-670 for use as a crop duster, and the registration became N4N since the second letter was dropped that year in U.S. registrations. By this time, however, simple engine changes did not affect the model designation of old airplanes. N4N became just a modified ASO, not the QSO it would have been had it been modified before the war or been built with the Continental A.70 engine, the original version of the R-670.

The rugged construction and good performance of the Waco 10 series made it suitable for light military work. Of course, the major powers were not interested, but Waco did a brisk business with both straight and taperwing 10s fitted with machine guns and bomb racks for lesser powers. These export models kept the original Waco 10 production line going into 1933. The domestic models had been replaced by the new F-model in 1930, but occasionally a civil Model 10 was sold after that.

The 1981 census shows 118 Waco 10s of various models still flying. Most of them are acknowledged recreational antiques but a few taperwings still fly on Experimental licenses for air shows, a tribute to a rugged airframe developed more than half a century ago. □

Intrigued by airplanes long before his first ride in a Travel Air at age 10, Peter Bowers, AOPA 54408, has since logged more than 4,200 hours.