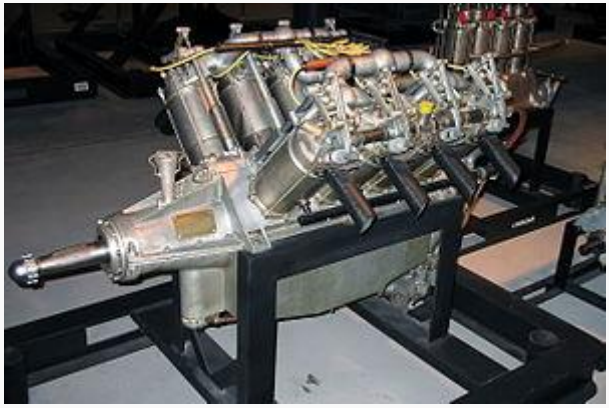
Curtiss OX-5

OX-5	
	
Preserved OX-5 engine	
Type	V-8 piston engine
Manufacturer	Curtiss Aeroplane and Motor Company
First run	1915
Number built	12,600

The **OX-5** was an early V-8 American liquid cooled aircraft engine built by Curtiss. It was the first US-designed engine to enter mass production, although it was considered obsolete when it did so in 1917. It nevertheless found widespread use on a number of aircraft, perhaps the most famous being the JN-4 "Jenny". Some 12,600 units were built through early 1919. The wide availability of the engine in the surplus market made it common until the 1930s, although it was considered unreliable for most of its service life. Today the engine can be found powering many Edwardian automobile racing specials on the historic racing scene.

The OX-5 was the last in a series of Glenn Curtiss designed V engines, which had started as a series of air-cooled V-twins for motorcycles in 1902. A modified version of one of these early designs was sold as an aircraft engine in 1906, and from then on the company's primary market was aircraft. The basic design had slowly expanded by adding

additional cylinders until they reached the V-8 in 1906. They also started enlarging the cylinders as well, but this led to cooling problems that required the introduction of water cooling in 1908. These early engines used a Flathead engine valve arrangement, which eventually gave way to a cross-flow cylinder with overhead valves in 1909, leading to improved volumetric efficiency. The US Navy ordered a version of this basic design in 1912 for its A-1 amphibious aircraft, which Curtiss supplied as the **OX**. These improvements and others were worked into what became the OX-5, which was first built in 1910. By this point engine design was a team effort; the team included Charles Manley, whose earlier Manley-Balzer engine had held the power-to-weight ratio record for 16 years.

Curtiss OX-5 at Canada Aviation Museum

Like most engines of the era, the OX-5's high-temperature areas were built mostly of cast iron, using individual cylinders bolted to a single aluminum crankcase, wrapped in a cooling jacket made of a nickel-copper alloy. Later versions used a brazed-on steel jacket instead. Cylinder heads were also attached to the crankcase, using X-shaped tie-downs on the top of the head attached to the block via four long bolts. Fuel was carbureted near the rear of the engine, then piped to the cylinders via two T-shaped pipes, the cylinders being arranged so the intake ports of any two in a bank were near each other. The cylinders had one intake and one exhaust valve, each operated by a pushrod from a camshaft running between the banks. This arrangement caused the outer exhaust valves to have a rather long rocker arm. The pushrods were arranged one inside the other, the exhaust valve rod being on the inside and the intake valve rod a tube around it. The aluminum camshaft bearings were a split type bolted together and held in place by lock screws. The pistons were cast aluminum.
The OX-5 was not considered particularly advanced, nor powerful, for its era. By this point rotary engines such as the Oberursel or Gnome-

Rhone were producing about 100 hp (75 kW), and newer in-lines were becoming available with 160 hp (120 kW) or more. Nevertheless the OX-5 had fairly good fuel economy as a result of its slow RPM, which made it useful for civilian aircraft. The OX-5 was used on the Laird Swallow, Travel Air 2000, Waco 9 and 10, the American Eagle, the Buhl-Verville CW-3 Airster, and some models of the Jenny. The primary reason for its popularity was its low cost after the war, with almost-new examples selling as low as $20. It was often used in boats as well as in aircraft.

The engine was considered unreliable, and as it was used on many primary trainers, but "unreliable" is a relative term. Aviation and engine technology, even at the end of WWI had not fully matured. There was no question the JN4 that the OX-5 powered in service was underpowered with the engine, but the OX-5 proved a much better engine than the Hall Scott A7A that was the Achilles' heel of the Standard J-1, the substitute "other" primary trainer. In particular the valve gear was fragile, and it had no provisions for lubrication other than grease and oil applied by hand, leading to overhaul times as short as fifty hours. Additionally the engine featured a single spark plug in each cylinder, and a single ignition system, in an era when ignition equipment was less reliable. Built by several contractors in large numbers, it suffered from uneven quality control. It must be noted, however that while the overwhelming majority of training accidents stateside were in J4N's, this was because J4N's were flown by the vast majority of neophyte airmen and it must be further noted that the accident rate in the US was for primary training was four times less than the advanced training rate in France (virtually all US airmen getting advanced training in France), approximately 2800 flying hours in the US primarily in OX-5 powered J4N's per fatality to 761 hours per fatality in France in other types. Very few fatal accidents were "caused" by engine failure, although the lack of power may have been the cause of the many "tailspins" that took about forty five percent of training lives. Anyone seeing a J4N today struggling into the air with an OX-5 can see very quickly that the J4N had to be flown in a narrow envelope. It should also be stated that the replacement of the A7A in Standard J-1's was contemplated, but the cost of $2,000.00 per aircraft compared with the need (by the time the J-1's were grounded in June 1918 J4N's were in sufficient supply) led to this idea's rejection. There is no question that the successful civilian post-war use of the OX-5 (even in civilian purchased and converted J-1's) was due to its relative reliability in the more aerodynamically advanced designs of the '20s, its

simplicity of operation, and of course it was inexpensive. By comparison the Hall Scott A7A created such a bad impression during the war that very few, if any, were used by civilian operators.

General characteristics

Top overhead view of OX-5 at Lone Star Flight Museum

- **Type:** 8-cylinder water-cooled 90° Vee piston engine
- **Bore:** 4.0 in (102 mm)
- **Stroke:** 5.0 in (127 mm)
- **Displacement:** 503 in^3 (8.2 l)
- **Length:** 56.75 in (1441.45 mm)
- **Width:** 29.75 in (755.65 mm)
- **Height:** 36.75 in (933.45 mm)
- **Dry weight:** 390 lb (177 kg)

Components

- **Valve train:** One intake and one exhaust valve per cylinder, pushrod-actuated
- **Fuel system:** Duplex Zenith Carburetor
- **Oil system:** Gear-pump 40 to 60 psi 3-gallon sump
- **Cooling system:** Water-cooled

Performance

- **Power output:**
  - 90 hp (67 kW) at 1,400 rpm
  - 105 hp (78 kW) at 1,800 rpm for brief periods

- **Specific power:** 0.21 hp/in³ (9.5 kW/l)
- **Compression ratio:** 4.9:1
- **Fuel consumption:** 8.0 US gal/h (30.8 l/h) at 75% power[4]
- **Specific fuel consumption:** 0.53 lb/(hp·h) (0.32 kg/(kW·h)) at 75% power
- **Oil consumption:** 0.5 US gal/h (1.9 l/h) at 75% power
- **Power-to-weight ratio:** 0.27 hp/lb (440 W/kg)