

Aircraft Used to Fight US Wildfires

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1. Introduction

I'm not even sure how the subject of this paper came to me. I believe it was while I was going through and proofing papers that were scheduled for posting within the then-future couple of months. However, once it had occurred, pretty quickly I realized how important it is. Although I do write about most forms of mobility, these articles mostly have to do with how to move away from greenhouse gas (GHG) emitting fuel to GHG-free power.

Considering how much GHG even a moderate forest and/or wild-land fire releases, and how much damage is caused by these fires, I don't care if the subject vehicles ever convert their fossil-fuel to something more climate-friendly. These aircrafts' function is easily the most climate-, people- and infrastructure-friendly in existence.

2. Aerial Fire-Fighting

Aerial firefighting is an essential component of wildfire suppression. Firefighting aircraft are used to drop fire retardants, water, and other suppressants on wildfires to help contain and extinguish them. Different types of firefighting aircraft are deployed based on the size and location of the fire, as well as the terrain and weather conditions.¹

There are several different types of firefighting aircraft, including single-engine air tankers, large air tankers, very large air tankers, water scoopers, and smokejumper aircraft. Each type of aircraft has its own unique capabilities and is used for specific firefighting operations. For example, single-engine air tankers are used for initial attack and rapid response, while large and very large air tankers are used for larger fires that require more water or retardant drops.

Below, we will explore the different types of firefighting aircraft and their capabilities, as well as the equipment used on these aircraft and the operations involved in aerial firefighting. We will also discuss the use of firefighting aircraft in different regions and answer some frequently asked questions about aerial firefighting.

2.1. Fundamentals of Aerial Firefighting

Aerial firefighting is an essential tool in the fight against wildfires. It involves the use of aircraft to drop water, fire retardants, and other fire suppression materials on fires from above. This method of firefighting is particularly effective in areas that are difficult to access by ground crews.

There are several types of aircraft used in aerial firefighting, each with its own unique capabilities and limitations. The most common types of aircraft used in aerial firefighting include helicopters, fixed-wing aircraft, and air tankers.

¹ Sean Walsh, "Which Aircraft are Used in Firefighting? A Comprehensive Guide," PilotPassion, September 4, 2024, <https://pilotpassion.com/which-aircraft-are-used-in-firefighting/>

Helicopters are versatile and can be used for a variety of tasks, including transporting firefighters and equipment, dropping water and fire retardants, and providing reconnaissance of the fire line. They are particularly effective in urban areas where there are buildings and other obstacles that can make it difficult for ground crews to access the fire.

Fixed-wing aircraft are typically used to drop fire retardants and water on the fire. They are faster and can carry more water and fire retardant than helicopters, making them ideal for larger fires. They can also be used to transport firefighters and equipment to the fire line.

Air tankers are specialized fixed-wing aircraft that are designed to drop large quantities of fire retardant on the fire. They are capable of dropping thousands of gallons of fire retardant at a time, making them ideal for fighting large wildfires.

Fire retardants are a critical component of aerial firefighting. They are chemicals that are dropped from aircraft onto the fire to slow its progress. Fire retardants are typically made up of a mixture of water, fertilizer, and other chemicals that are designed to stick to vegetation and other materials to prevent them from catching fire.

The use of fire retardants is an important part of wildfire suppression efforts. They can be used to expand and protect fire lines, which are areas where vegetation has been removed to prevent the spread of the fire. Fire retardants can also be used to protect structures and other valuable assets from the fire.

Overall, aerial firefighting is an essential tool in the fight against wildfires. It allows firefighters to access areas that are difficult or impossible to reach by ground, and it provides a quick and effective way to slow the progress of the fire. By working together with ground crews, aerial firefighting can help to save lives, protect property, and preserve our natural resources.

2.2. Different Types of Firefighting Aircraft

The subsections below are intended to be generic-description of the most common types of aircraft. The following sections deal with two important organizations, provide additional information and types of firefighting aircraft.

2.2.1. Air Tankers

Air tankers are fixed-wing aircraft designed to drop fire retardant over a wildfire. These aircraft are typically converted cargo planes, such as the McDonnell Douglas DC-10 or the Lockheed C-130Q, that can carry up to 15,000 gallons of retardant. Large airtankers like the DC-10 can drop a line of retardant up to 3 miles long, while very large airtankers like the Boeing 747 Supertanker can drop 19,200 gallons of retardant in a single pass.

2.2.2. Water Scoopers

Water scoopers are fixed-wing aircraft designed to scoop water from a nearby lake or river and drop it over the fire. These aircraft are typically smaller than air tankers and can carry up to 1,600 gallons of water. The Canadair CL-415 is a popular water scooper that can refill its tanks in just 12 seconds.

2.2.3. Smokejumper Aircraft

Smokejumper aircraft are used to transport smokejumpers, firefighters who parachute into remote areas to fight fires. These aircraft are typically small planes, such as the DeHavilland DH-6 300 Series Twin Otter or the Dornier 228, that can carry up to 10 smokejumpers and their gear.

2.2.4. Air Attack Planes

Air attack planes are used to coordinate the firefighting efforts from the air. These aircraft are typically small planes, such as the Twin Commander 500 and 600, that are equipped with radios and other communication tools. Air attack planes are used to direct the air tankers and water scoopers to their targets and ensure that the firefighting efforts are coordinated and effective.

2.2.5. Single Engine Air Tankers

Single engine air tankers are smaller air tankers that can carry up to 800 gallons of retardant. These aircraft are typically used in areas where larger air tankers cannot operate due to terrain or other limitations.

2.2.6. Lead Planes

Lead planes are used to guide the air tankers to their targets and ensure that the retardant is dropped in the right place. These aircraft are typically small planes, such as the P2V or the MD-87, that fly ahead of the air tankers and mark the drop zone with smoke.

In conclusion, there are several types of firefighting aircraft used to fight wildfires, each with its own unique capabilities and limitations. From large air tankers to small smokejumper aircraft, these planes play a crucial role in protecting lives and property from the devastating effects of wildfires.

Author's comment: This section (2) and reference 1 uses a general description that I found, whereas sections 3 and 4 below cover specific aircraft used by major western agencies and organizations, as there are some slight differences in nomenclature, etc.

3. U.S. Forest Service

The Forest Service uses planes of many types and sizes to manage wildland fires. Some are owned by the Forest Service, many are leased or contracted and during times of high fire activity, military aircraft may be activated. When aircraft aren't being used to support wildland fires, they may be used for other natural resource management activities, such as conducting aerial surveys of wildlife populations and forest health.²

² US Forest Service, Department of Agriculture, "Planes," <https://www.fs.usda.gov/managing-land/fire/planes>

3.1. Types and Models of Aircraft

The following subsections identify the types of aircraft used, and your author will try to adjust these such that they are consistent with section 2.

3.1.1. Single Engine Airtankers

Single Engine Airtankers (SEATs) can deliver up to 800 gallons of fire retardant to support firefighters on the ground. These small airplanes can reload and operate in areas where larger airtankers cannot. Aircraft types: Air Tractor AT-802.

3.1.2. Large Airtankers

Large Airtankers can deliver from 2,000 to 4,000 gallons of fire retardant to support firefighters on the ground. Aircraft types: P2V, HC-130H, BAe-146, MD-87, C-130Q, RJ85, C-130 H & J equipped with Modular Airborne Fire Fighting Systems.

3.1.3. Very Large Airtankers

Very Large Airtankers are capable of delivering over 8,000 gallons of fire retardant to support firefighters on the ground. Aircraft Type: DC-10.

3.1.4. Water Scoopers

Water Scoopers are amphibious aircraft that skim the surface of a water body and scoop water into an onboard tank and then drop it on a fire. Aircraft types: Bombardier CL-415 and Air Tractor Fire Boss.

3.1.5. Smokejumper Aircraft

Smokejumper aircraft deliver smokejumpers and cargo by parachute for initial attack and extended support of wildland fires. Each of the aircraft can carry eight to ten Smokejumpers and their initial supply of gear. Aircraft types: DeHavilland DH-6 300 series Twin Otter, Shorts Sherpa C-23A and SD3-60, Dornier 228, and CASA 212.

3.1.6. Unmanned Aircraft Systems

Unmanned Aircraft Systems (UAS) have great potential for use on wildland fires and in natural resource management. In contrast, unauthorized public UAS flights over or near wildfires threaten the safety of aerial and ground firefighters and users are encouraged to “know before you fly”.

Author’s comment: Note that this type of aircraft is not seen earlier. However, I believe this these have a great future, particularly as they become more specialized for the above missions. They are both low-cost, and expendable, where manned aircraft are neither.

3.1.7. Air Attack

Air tactical or air attack planes coordinate aerial firefighting aircraft over wildland fires. They provide vital eyes in the sky for firefighters on the ground, and ensure safe aviation operations. Aircraft types: Twin Commander 500 and 600 are most common.

4. Western Fire Chiefs Association

You will note that the format of the descriptions below is different than the above organization and this section contains additional information.

4.1. Types and Models of Aircraft

The following subsections identify the types of aircraft used, and your author will try to adjust these such that they are consistent with section 2.

4.1.1. Plane Type #1: Single Engine Airtanker

Aircraft Types: Air Tractor AT-802³

Top Speed: 221 mph

Capacity: up to 800 gallons of fire retardant

The single-engine airtanker (SEAT) is the smallest of the firefighting planes. It is mostly used to put out hotspots – areas of land where a fire has either just started or is hot enough to blaze up at any moment. Because of its small size, it only carries about 800 gallons of fire retardant. However, its size can also be an advantage, as it can easily land and take off on various types of terrain with very little runway.

4.1.2. Plane Type #2: Large Airtanker

Aircraft Types: P2V, HC-130H, BAe-146, MD-87, C-130Q, RJ85, C-130 H & J

Top Speed: British Aerospace 146 (BAe-146) at 498 mph⁴

Capacity: 2,000 to 4,000 gallons of fire retardant

Large airtanker (LAT) planes, with their capacity for 2,000 to 4,000 gallons of fire-retardant, offer higher and more widespread coverage. This is helpful for putting out forest fires, as they can fly above the canopy. However, their size can make it difficult to land and take off.

4.1.3. Plane Type #3: Very Large Airtanker

Aircraft Types: Boeing 747 Supertanker and DC-10

Top Speed: Boeing 747 Supertanker at 598 mph⁵

Capacity: over 8,000 gallons of fire retardant

Very large airtankers (VLATs) are extremely useful for dousing vast swaths of landscape in fire retardant. These planes are designed to hold over 8,000 gallons and dispense at 250 ft above the ground or a forest canopy. The Boeing 747 Supertanker can hold up to 24,000 gallons.



4.1.4. Plane Type #4: Water Scooper

Aircraft Types: Bombardier CL-415 and Air Tractor Fire Boss

Top Speed: Bombardier CL-415 at 223 mph⁶

Capacity: up to 1,600 gallons of water

A water scooper is exactly what it sounds like; a small plane that flies just over a body of water, such as a lake, and intake up to 1,600 gallons in a span of about 12 seconds.

³ Western Fire Chiefs Assn., “Firefighting Planes: An In-Depth Guide,” March 1, 2024, <https://wfca.com/wildfire-articles/firefighting-planes-an-in-depth-guide/>

⁴ Wikipedia Article on the British Aerospace 146, https://en.wikipedia.org/wiki/British_Aerospace_146

⁵ Wikipedia Article on the 747 Supertanker, https://en.wikipedia.org/wiki/747_Supertanker

⁶ Wikipedia Article on the Canadair CL-415, https://en.wikipedia.org/wiki/Canadair_CL-415

This allows it to refill its water reservoirs at near full speed without having to circle back to a water station. They fly low, no more than 150 ft above ground level, so that they can more accurately dispense water on specific areas to help keep the fire from spreading.

4.1.5. Plane Type #5: Smokejumper Aircraft

Aircraft Types: DeHavilland DH-6 300 series Twin Otter, Short Sherpa C-23A and SD3-60, Dornier 228, and CASA 212

Top Speed: Dornier 228 at 269 mph⁷

Capacity: 8-10 smokejumpers

Smokejumpers are firefighters who are specially trained to fight fires. The smokejumper aircraft drops 8-10 of them, as well as cargo, into areas where a wildfire is burning close by. In some cases, this is the only means of transport to a wildfire, depending on where it's burning and if the roads leading to it are blocked.

4.1.6. Aerial Supervision Module/Lead Plane

Aircraft Types: Beechcraft King Air 90 and King Air 200

Top Speed: Beechcraft King Air 90 at 311 mph⁸

Aerial supervision modules, also known as lead planes, are typically the types of firefighting planes to head to the scene of a wildfire first. Their job is to assess the area for the rest of their team. They also mark the areas where airtankers should dispense their fire retardants by releasing a plume of white smoke.

Author's comment: Note that this category is not seen above, although it seems like there may be some overlap with the next category which is seen above.

4.1.7. Plane Type #7: Air Attack Plane

Aircraft Types: Twin Commander 500 and 600

Top Speed: Twin Commander 600 at 498 mph⁹

Air attack planes are small, highly maneuverable planes that allow the leader of the air contingent of firefighters to get up close and personal with the wildfire. From the vantage point of a Twin Commander 500 or 600, the Air Tactical Group Supervisor can choose access points to the wildfire for the units on the ground as well as decide where the air tankers should dispense fire retardant.



Final author's comment: There is one more source that I didn't use in this paper, but has good information, particularly if a reader wants to review this subject from an international perspective. This is referenced here.¹⁰

⁷ Wikipedia Article on Dornier 228, https://en.wikipedia.org/wiki/Dornier_228

⁸ Wikipedia Article on Beechcraft King Air, Model 90 or 100 series, note that it provides a link to the 200 series, https://en.wikipedia.org/wiki/Beechcraft_King_Air

⁹ Wikipedia Article on Aero Commander 500 family, note that it does not have a model 600 per se, but it does have a model 680 (above image), etc. https://en.wikipedia.org/wiki/Aero_Commander_500_family

¹⁰ Wikipedia Article on Aerial Firefighting, https://en.wikipedia.org/wiki/Aerial_firefighting