High fuel prices have triggered the development of fuel saving devices, techniques and systems. An airline technique of single-engine taxiing is taken further by WheelTug. WheelTug is an electric motor in an aircraft's nosewheels that allows it to taxi without engine power.

Near zero taxi fuel with wheeltug

The constant rise in fuel prices since 2002 has seen numerous operational techniques proposed and products come available on the market to help airlines reduce operational fuel consumption or to make fuel burn savings. One technique has been for airlines to taxi with a single engine, and start additional engines late in the taxi prior to take-off. A new product, WheelTug, takes this technique further by allowing aircraft to reverse from the gate and taxi under the power of electric motors in the nose wheel. These motors take power from the aircraft's auxiliary power unit (APU). Engines are then started late in the taxi, about four to five minutes prior to take-off. Certification of WheelTug is expected in mid-2009, and can provide airlines with numerous benefits, the most obvious being the saving of fuel. WheelTug plc is offering the system to airlines on a monthly fee or lease rate basis, thereby allowing them to avoid having to make any capital investment.

WheelTug plc

WheelTug plc is a Canadian company, and is a member of the Borealis family of companies. This incorporated Chorus Motors in 1999, which developed the electric motors that are the core of the WheelTug product.

The WheelTug system is a simple component, the main part of which comprises two electric motors housed in the rims of the two nose wheels. They have been developed to provide enough high-speed torque to drive the aircraft in either a forward or reverse direction.

Using WheelTug means that the traditional method of aircraft pushback from an airport terminal gate with a large ground tug, and with a ground marshal walking by the side while engines are started and controls tested, will no longer be necessary. After reversing from the gate the tug has to be disconnected and driven away while engines are still being started and stabilising. Engines then run for the complete taxi and queueing time.

WheelTug will be powerful enough to reverse the aircraft from the gate under its own power with just the APU running. The ground tug will no longer be required, and the ground marshal will control the reversing of the aircraft via a cable plugged into the nose gear. Once the aircraft has reversed, the cable will be disconnected and the flightcrew will control WheelTug via a simple control in the flightdeck. Engines will then be started four to five minutes prior to take-off, giving them enough time to stabilise and warm up.

The average taxi time in the US is 25 minutes, so the main benefit of WheelTug is to save taxi fuel burn. A second benefit is that ground tugs are no longer required, thereby reducing ground handling costs. A third benefit is that ground noise emissions will be reduced, particularly near the airport terminal.

WheelTug also has a military application, since the system has other operational benefits.

WheelTug has tested the concept on several aircraft, including the 737NG and 767-200. Delta Airlines is the launch customer, and expects to put the system into service before the end of 2009. Delta has an exclusive development partner. Delta has certain rights to installation and maintenance of airline 737NG WheelTugs. WheelTug says it has a lot of interest in the concept for use on A320s and Embraer E-Jets.

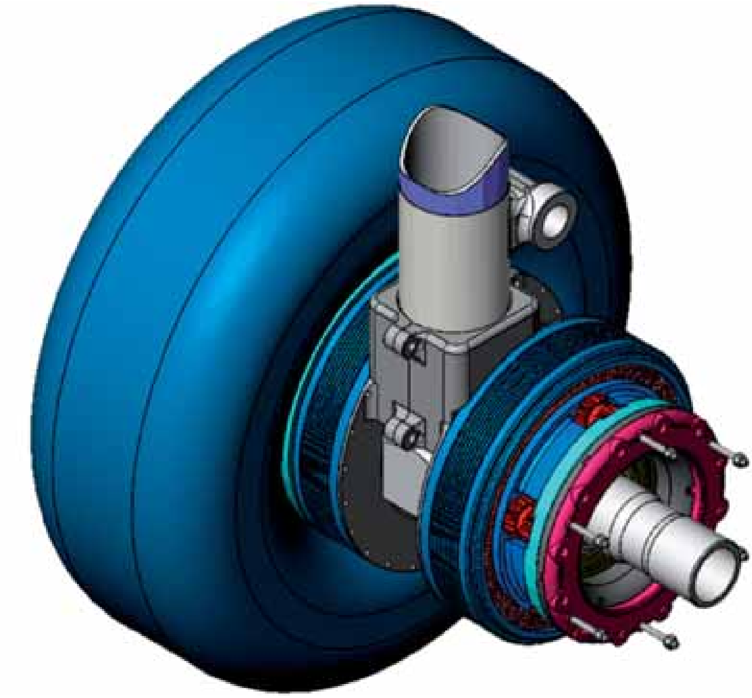
The weight of the system varies, but is about 220lbs for a 737NG and A320-sized aircraft. This is equal to about one passenger or some belly freight. The weight increases for the system when it is installed on larger aircraft types. WheelTug can be fitted to the wheel rims of the nose wheels, and so does not require any additional space to the nose gear well. Since this means that WheelTug can be retrofitted to existing aircraft, more than 6,000 737s and A320 family aircraft could therefore benefit from its installation. The system has been designed so that this can be carried out during a typical C check. This involves installation of the electric motors in the nosewheel rims, a flightdeck control, wiring harness and an inverter in the avionics bay.

WheelTug has a weight of about 300lbs for a 737 or A320, but will save about 200lbs in fuel per flight, and up to 400lbs in many cases. With a 200lbs fuel weight saving the aircraft will have a net weight gain of 100lbs. Longer taxi times will result in a higher fuel weight saving, so there will be a net weight reduction.

Operational benefits

As described, the principal benefit of WheelTug is to save fuel during pushback, engine start and taxiing. The system provides several other spin-off benefits.

"We estimate that the system will save an airline up to 21lbs per minute during taxi for a 737- or A320-sized aircraft," says Isaiah Cox, chief executive officer at WheelTug. "That is, 25lbs per minute is what these aircraft burn with both engines at idle during the taxi. Some airlines taxi with a single engine for part of the taxi time. By comparison, the APU burns about 4lbs per minute, and so the net saving is about 21lbs per minute. We have analysed taxi and flight times, and the average taxi time per flight cycle (FC) in the US is 25 minutes when considering the taxi time prior to take-off and after landing. Taxi times are considerably longer at congested airports, and the block time for the Washington-New York route is 80-120 minutes for a flight time



The core of the WheelTug product is two electric motors in the aircraft's nosewheel. This is electrically powered, drawing power from the APU. Besides saving fuel, WheelTug provides many other benefits, including the elimination of the traditional pushback at departure.

of 35 minutes in many cases, which means that taxi time is often more than one hour. All this time engines are running. Engines have to be run for three or four minutes prior to take-off to get them stabilised, and also run for three minutes after landing to let them cool down prior to shutting them down. Taking this, and the fuel used by the APU into consideration, we expect the system to save about 200lbs of fuel per FC, for an average taxi time of 25 minutes, taxiing in and out."

Aircraft such as the 737 and A320 operating 1,800-2,000FC annually will therefore save 360,000-400,000lbs or 54,000-60,000 US Gallons (USG) of fuel per year. At current fuel prices this is worth $80,000-90,000 per year. Fuel prices are low compared to the past three to four years, and are likely to reach $2.50 per USG once the global economy has recovered. This would increase the saving to $135,000-150,000 per year.

WheelTug estimates that in addition to fuel saved, CO2 emissions will also be reduced by about 1 million lbs per year for 737- and A320-sized aircraft.

"The total pushback, engine start and taxi time is also reduced," continues Cox. "This is because it takes two or three minutes to disconnect the pushback ground tug and for it to drive clear. With WheelTug the aircraft can reverse from the gate, and the ground marshal just has to disconnect the lead and walk clear before the aircraft moves forward. We think it will be possible to save 2-3 minutes' taxi time because the conventional pushback is removed. It will also be possible for aircraft to benefit from shorter turnaround times because there is no need to connect a tug prior to departure. At non-slot controlled airports, aircraft would therefore be able to queue one to three spaces ahead of other aircraft, and so depart six to 10 minutes earlier than with a conventional pushback."

The additional benefit that comes from this time saving is the possibility of increasing aircraft utilisation in high-frequency operations. Cox even claims it is possible for some operators to get an extra FC per day where aircraft are not too restricted by airport congestion. "We think it is even possible for airlines to get some dispensations at airports that have operational curfews. This is because a lot of noise is emitted by aircraft taxiing with all engines running," says Cox.

Another possibility is that aircraft could be remotely controlled by air traffic control (ATC). This would suit operations, such as FedEx and UPS, with a large number of aircraft arriving and departing in waves. It should be noted that although WheelTug is expected to be economic for high-frequency operations, it will not be for low-frequency ones. Not all aircraft will therefore be retrofitted with WheelTug.

"Another main benefit is that airlines can save on ground-handling costs," continues Cox. "We estimate pushback costs are $40-75 per FC, whether done by a third party or performed in-house. This takes account of the cost of equipment, labour, fuel, insurance, maintenance and breakages." For an aircraft completing 1,800-2,000FC per year, a saving of $75,000-150,000 can be realised. The pushback process is also simplified, requires less people and communications, and so is less prone to accidents. Many accidents occur between ground vehicles and aircraft, incurring substantial damage to aircraft and ground equipment which incurs a high cost for casualty maintenance. Using WheelTug will also reduce the jet blast damage that occurs near terminal buildings.

There are other spin-off benefits that are realised in aircraft maintenance costs. The first is that engine running time is reduced for the same flight time or block time, since engines are started later in the departure taxi and shut down earlier in the arrival taxi. This not only preserves on-wing life, but also saves engine time on power-by-the-hour (PBH) contracts. Cox estimates that this can be up to 20 minutes per flight. This equals 600-650 engine flight hours per year. At typical PBH rates, this generates a saving of $180,000-230,000 per year for both engines.

Cox adds that less running time on the ground reduces the occurrence of foreign object damage (FOD) to engines, particularly near terminal buildings.

The shorter ground running time also reduces the incidence of nicks and other minor damage to engine airfoils, as well as the accumulation of dust in the engine. These both improve engine on-wing life and operational efficiency.

The life of wheel brakes and tyres is also extended, since pilots will no longer need to apply brakes while the engine is running. WheelTug does not operate antagonistically against the engines, and the aircraft can simply be slowed or stopped.

Economics

The savings derived from lower fuel burn, pushback costs and prolonged engine life can total $350,000-530,000 per year. The additional benefits of less engine damage and dust accumulation, fewer accidents and casualty maintenance, and improved aircraft utilisation can all add up to a similar amount.

WheelTug plans to lease systems to airlines, and WheelTug will retain ownership and the responsibility for maintenance. "This way airlines will not have to make any capital expenditure. We are targeting a lease rate of $30,000-40,000 per month per aircraft, or $360,000-480,000 per year. This will be about half of all savings realised by the system," says Cox. AC