Steel Braking on Aircraft

Welwyn Dynamic Braking Resistors in Avionics

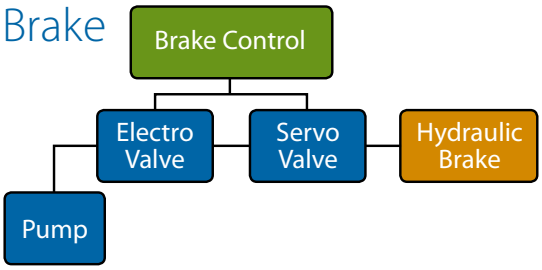
The current trend is for more electronics in civil and Military aircraft. Intricacy, fragility and weight issues of mechanical assemblies and hydro mechanical flight controls means they are slowly being replaced with electronic brake actuator systems. Custom WDBRs (Welwyn Dynamic Braking Resistors) with there low profile, robust construction and relative low weight are proving an ideal choice for power dump, chopper or regenerative resistors in applications such as electronic brakes (EBAC), flight controls and flight refuelling systems.

In 2004, the Boeing 787 Dreamliner was the first commercial airline to adopt this electronic actuated braking technology, replacing the traditional hydraulic brake-by-wire (see figure below). Electrically operated brakes allow direct control and require significantly fewer component parts. The electronic braking actuator controller (EBAC) utilises the electric power supplied by the aircraft and then to operate the brakes. Pressure on the brake disks is controlled by means of these electromechanical actuators instead of hydraulic pumps to produce pressure on each brake (see figure below). This is known as electrically actuated brake-by-wire technology. The electric brake system, with multiple motors driving each brake, will have the advantage of operating independently on each of the four main wheels (with 4 EBAC units per plane), reducing the risk of total system shutdown in the event of a motor failure (there are 8 x 500W motors) or a brake actuator unable to function.

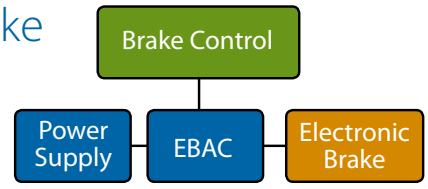
Benefits of the electronic drive include:-

- easier and faster installation during the aircraft assembly process
- reduced brake maintenance and operating costs
- simpler maintenance than hydraulic equipment, where housing and wheels needed removing
- more efficient brake wear and an ability to sense and monitor this brake wear from the brake control systems in real-time
- response time optimised
- better safety as there is no flammable hydraulic fluid leakage, which poses a fire risk around hot brakes
- more environmentally friendly, no toxic fluids leakage
- lighter aircraft as a result of removing the hydraulics and associated equipment, e.g. pipelines, which in turn increases fuel efficiency

Hydraulic Brake



Electronic Brake



EBAC (Brake-by-Wire) System for Boeing 787

Welwyn's dynamic braking resistors have been implemented in the EBAC system for the Boeing 787 Dreamliner, with a total of eight custom designed braking resistors per plane. Its planar construction, coupled with high power capability gives this resistor an edge over competitor's products. The low thermal mass of the WDBR gives the advantage of weight saving and reduced fuel consumption.

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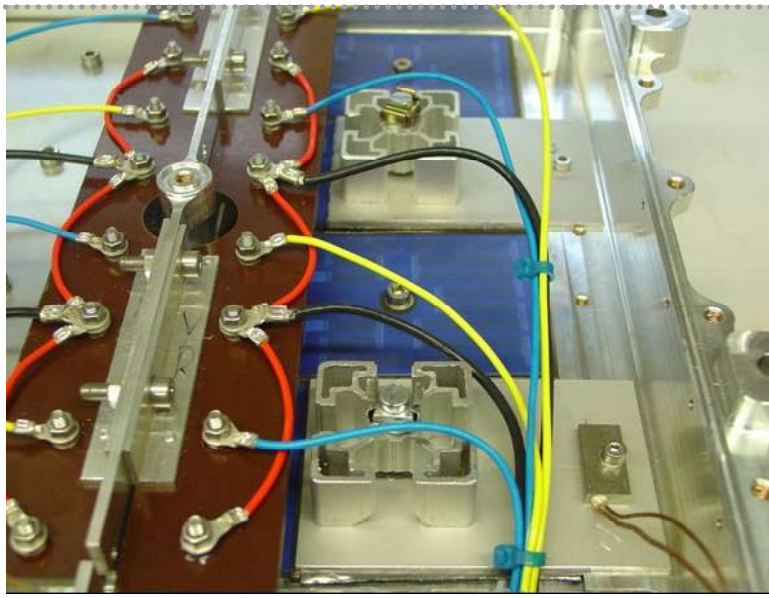
Flight Re-fueling for the A400M & A330M

An electronic brake actuator system has been designed in for the air-to-air hose drum drive refuelling (HDDR) of the Airbus A400M and A330-200 MRTT (Multi Role Tanker Transport) tankers. This air-to-air refuelling is the process of transferring fuel from one aircraft (tanker) to another (receiver) during flight. This refuelling technique (probe and drogue system) uses a flexible hose that trails from the tanker aircraft. A drogue is fitted with a valve at the narrow end to the flexible hose, and provides a funnel to aid insertion of the receiver aircraft probe into the hose. The hose itself is connected to the Hose Drum Unit and is reeled back completely when not in use. At the end of the probe is a valve that opens only when mated with the drogue, allowing fuel to pass from tanker to receiver. At the initial contact, the tanker's main refuelling valve also opens, allows fuel to flow into this receptor probe. Once the transfer is completed, these valves closed and the drogue and probe are automatically retracted. The benefit of this drogue and probe system is that it is a simpler and cheaper tanker design. Multipoint hose and probe systems can be equipped on air tankers allowing two or more aircraft to be refuelled simultaneously. Other aircrafts such as helicopters with suitable equipment can also be refuelled by this method. In the refuelling application for the two military planes, A400M and A300MRTT, conventional motor drives with hydraulic systems are replaced with electronics actuator control devices with associated dump resistor packs. When the motor stops, the generated back EMF is dumped into this resistor pack and is dissipated as heat.



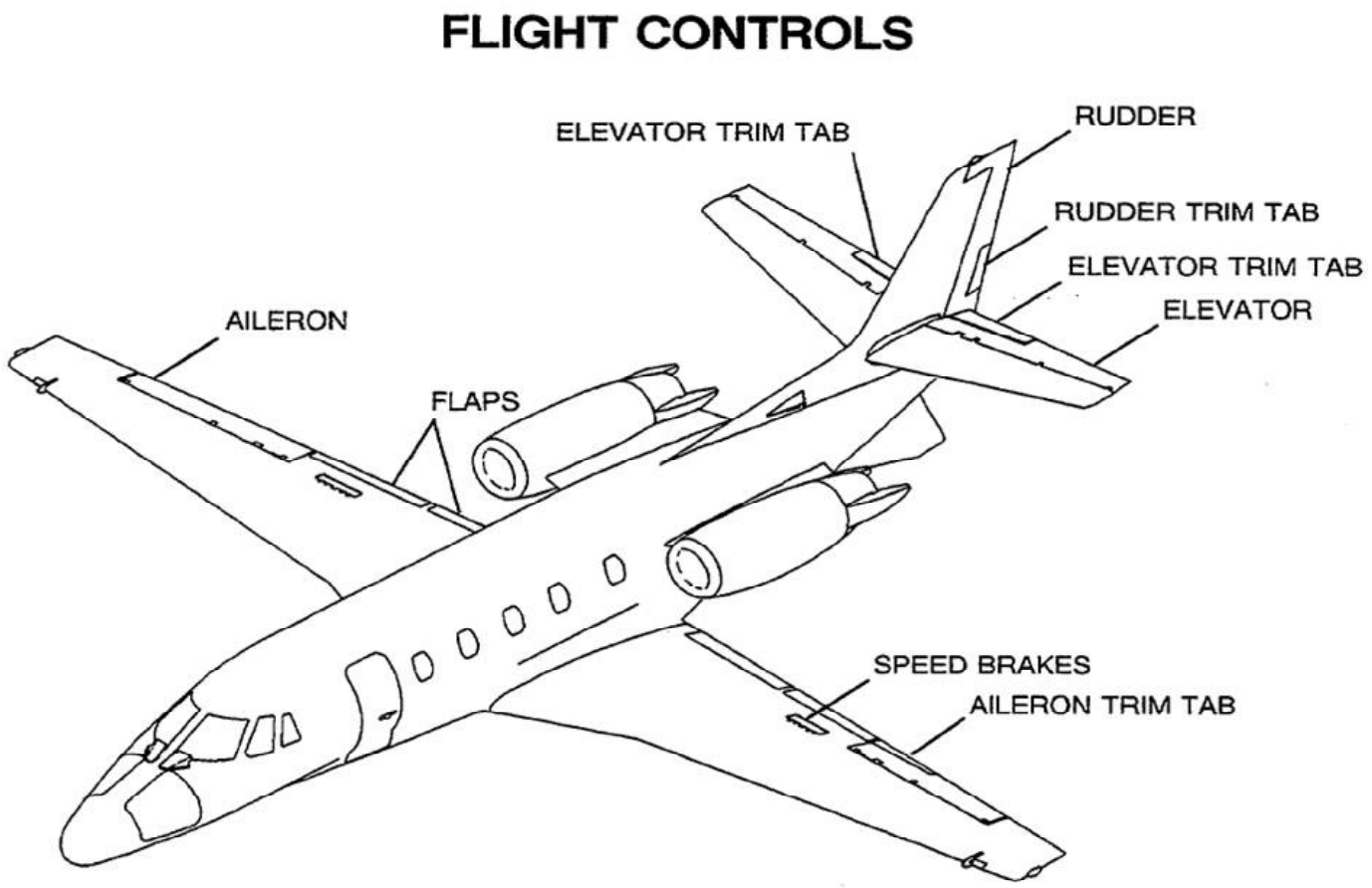
Dump Resistor Pack

Eight customed WDBRs steel braking resistors are used in this dump resistor pack unit with increased power dissipation achieved from both top and bottom heat sinking "sandwich" configuration as shown in Figure right. There are two such units per plane. As in the above, these custom braking resistors were also chosen in preference to other resistor types because of its planar construction and high power performance.

Flight controls for the A400M, A330M, A350 and A380.

Custom design WDBRs are also being used in the primary flight control systems with associated electronics as dump/chopper/regenerative resistors. These are used in Aileron (roll control), Elevators (pitch control), Rudders (yaw control) and Spoilers applications. Rudder, Aileron and Elevator actuators together with their derivatives are among the most flight critical components of aircraft, and are subjected to the most rigorous performance testing particularly in military aircraft.

Lightweight, robust, low profiles, superior power and heat dissipation capabilities of these steel resistors are seen as major advantages and are chosen and designed-in for the military tanker planes A400M and A330-MRTT and for civil aircraft programmes such as A350 XWB, and possibly in A320. There are several other programmes being considered, including the Airbus A380 using WDBR resistors for their brake actuator control systems.



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