

# **Appendix 3**

## **Group Chairman's Factual Report**

### **Human Performance**

**DCA06MA009**

**Boeing Flight Crew Training Manual (FCTM)  
Dated October 31, 2005**

**737NG (TM) Wheel Brakes**

## Wheel Brakes

Braking force is proportional to the force of the tires on the runway and the coefficient of friction between the tires and the runway. The contact area normally changes little during the braking cycle. The perpendicular force comes from airplane weight and any downward aerodynamic force such as speedbrakes.

The coefficient of friction depends on the tire condition and runway surface, (e.g. concrete, asphalt, dry, wet or icy).

### Automatic Brakes

Boeing recommends that whenever runway limited, using higher than normal approach speeds, landing on slippery runways or landing in a crosswind, the autobrake system be used.

For normal operation of the autobrake system select a deceleration setting.

Settings include:

- **MAX:** Used when minimum stopping distance is required. Deceleration rate is less than that produced by full manual braking
- **MED (2 or 3, as installed):** Should be used for wet or slippery runways or when landing rollout distance is limited
- **MIN (1, as installed):** These settings provide a moderate deceleration effect suitable for all routine operations.

Flight crew/airline experience with airplane characteristics relative to the various runway conditions routinely encountered provide initial guidance as to the desirable level of deceleration selected.

Immediate initiation of reverse thrust at main gear touchdown and full reverse thrust allow the autobrake system to reduce brake pressure to the minimum level. Since the autobrake system senses deceleration and modulates brake pressure accordingly, the proper application of reverse thrust results in reduced braking for a large portion of the landing roll.

The importance of establishing the desired reverse thrust level as soon as possible after touchdown cannot be overemphasized. This minimizes brake temperatures and tire and brake wear and reduces stopping distance on very slippery runways.

The use of minimum reverse thrust almost doubles the brake energy requirements and can result in brake temperatures much higher than normal.

After touchdown, crewmembers should be alert for autobrake disengagement annunciations. The PM should notify the PF anytime the autobrakes disengage.

If stopping distance is not assured with autobrakes engaged, the PF should immediately apply manual braking sufficient to assure deceleration to a safe taxi speed within the remaining runway.

A table in the PI section of the QRH shows the relative stopping capabilities of the available autobrake selections.

### **Transition to Manual Braking**

The speed at which the transition from autobrakes to manual braking is made depends upon airplane deceleration rate, runway conditions and stopping requirements. When transitioning to manual braking, keep the speedbrakes deployed and use reverse thrust as required until taxi speed. This is especially important when nearing the end of the runway where rubber deposits affect stopping ability.

When transitioning from the autobrake system to manual braking, the PF should notify the PM. Techniques for release of autobrakes can affect passenger comfort and stopping distance. These techniques are:

- stow the speed brake handle. When stopping distance within the remaining runway is assured, this method provides a smooth transition to manual braking, is effective before or after thrust reversers are stowed, and is less dependent on manual braking technique
- smoothly apply brake pedal force as in a normal stop, until the autobrake system disarms. Following disarming of the autobrakes, smoothly release brake pedal pressure. Disarming the autobrakes before coming out of reverse thrust provides a smooth transition to manual braking
- manually position the autobrake selector off (normally done by the PM at the direction of the PF).

### **Manual Braking**

The following technique for manual braking provides optimum braking for all runway conditions:

The pilot's seat and rudder pedals should be adjusted so that it is possible to apply maximum braking with full rudder deflection.

Immediately after main gear touchdown, smoothly apply a constant brake pedal pressure for the desired braking. For short or slippery runways, use full brake pedal pressure.

- do not attempt to modulate, pump or improve the braking by any other special techniques
- do not release the brake pedal pressure until the airplane speed has been reduced to a safe taxi speed
- the antiskid system stops the airplane for all runway conditions in a shorter distance than is possible with either antiskid off or brake pedal modulation.