

DC-10 AUTOMATIC LANDING SYSTEM (Auto Land)

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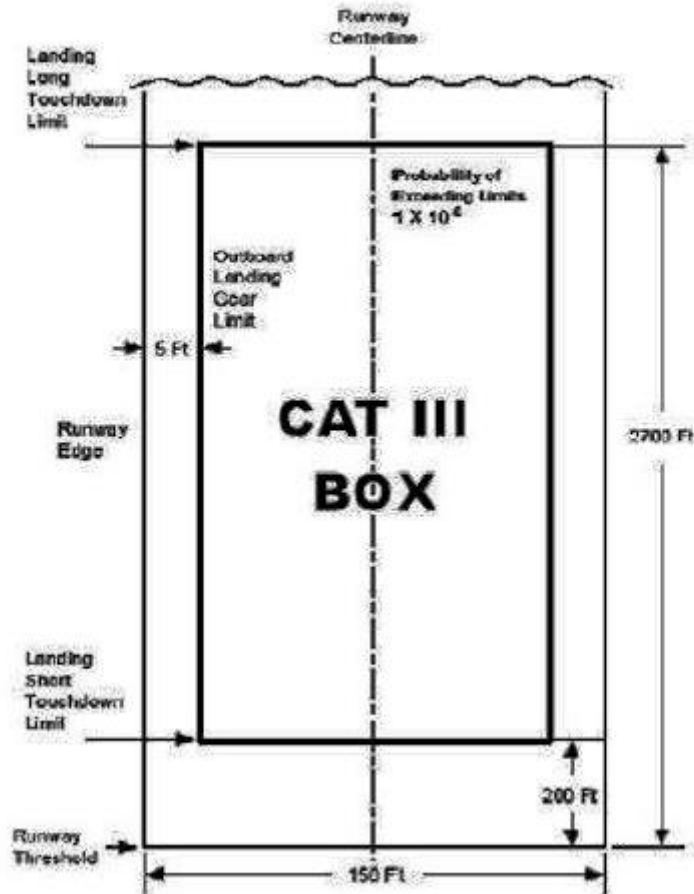
The DC-10 unique design features include an autopilot fail-operational automatic landing mode (auto land) that allows for completely hands-off landings; this includes tracking the localizer and glideslope, a runway alignment function, airplane flare and automatic throttle retard, main wheel touch down/wheel spin up, nose lowering, and a rollout mode to track the runway center-line! Such capability (when activated and maintained) can be utilized anytime the pilots elect to use it, but it is primarily intended for use during low visibility (CAT III) weather conditions.

During my time as a Customer Service Principal Technical Specialist at McDonnell Douglas as a member of the Flight Guidance and Navigation group, my specific specialty was the DC-10 automatic landing system. In this capacity, I had the privilege of assisting numerous Customer airlines in activating and troubleshooting the function and providing maintenance training. EXCITING times indeed! Later, I authored a 105-page "DC-10 Auto Land System Circuit Functional Description and Maintenance Information" article that McDonnell Douglas published in a Special Supplement to the Douglas Service magazine during July, 1982. My goal was to share my knowledge of this complex system in a simple manner such that our Customers didn't have to spend years studying the system to understand it and provide effective maintenance!

If auto land-capable equipment is installed in any commercial transport aircraft (DC-10 and all current modern-types) and is to be used for operations in low visibility conditions (CAT III weather minima), the system must be shown (via airframe manufacturer's flight tests, etc.) that it meets stringent FAA requirements (AC 120-28D, 7/13/99) - before FAA certification can be obtained. Additionally, the airline requires FAA approval to actually operate the system in revenue service. The very basic criteria for certification of the system itself is that the aircraft, while under fully-automatic, hands-off control, must be capable of consistently landing itself within a "CAT III Box" on the runway, as I have labeled on the diagram on the next page. In fact, the probability of a landing not inside this box must be demonstrated to be 1×10^{-6} ; in other words, very improbable. The CAT III Box is based on a 150-foot-wide (45.7 meters) runway. I believe the diagram I have included here is mostly self-explanatory except for possibly one point: the aircraft's outboard main landing gear can actually touch down 70 feet (21.3 meters) from the runway centerline and this would be an acceptable landing. Of course during all such off-centerline landings, upon engagement of the automatic landing system's roll out mode, the aircraft will steer itself back to the runway centerline.



FAA AC 120-28D, 7/13/99 CRITERIA



Additional System Certification Criteria:

- Bank angle: The probability of a wing or an engine touching the ground: 1×10^{-7}
- If the airplane arrives at 100 feet altitude and the fail-operational mode is engaged (DUAL LAND for the DC-10), the probability of any single failure that will affect the flight path of the airplane from the 100-feet point to touchdown: 1×10^{-9}