ILS Categories

a. Introduction
While the Cat I ILS is just fine for most situations, autolandings made in extremely low visibility require use of Cat III ILS procedures. As a practical matter — it's expensive and difficult to qualify — Cat III autoland authority is really granted to airline operators of large turbine aircraft only.

The higher the ILS category (I, II, or III), the lower the minimums that are allowed. In the USA, approach minimums are based on reported visibility. In some countries and for a few airports in the United States with unique terrain considerations, minimums are expressed in terms of both a ceiling and a visibility. A ceiling minimum, where it exists, should not be confused with a decision height [DH]. The ceiling minimum is simply the lowest reported ceiling for which one can legally accept the approach. The DH is the point at which a missed approach must be commenced, if certain approach lighting or other runway environment references have not been visually acquired by the pilot.

b. Category Details
Cat I ILS, with which most instrument-rated pilots are familiar, utilizes a DH of not less than 200 feet. Visibility minimums are usually one half mile or 2,400 feet runway visual range and may be reduced to 1,800 feet RVR if operative touchdown zone and centerline lights are available.

Cat II ILS has a DH of less than 200 feet, but not less than 100 feet, with visibility minimums of between 1,800 RVR and 1,200 RVR. Use of a Cat II ILS requires certain additional aircraft equipment, ground facilities, and pilot training. Any instrument-rated general aviation pilot may seek Cat II authority from the FAA, although this has proved to be something of a rarity. Mostly, it is airlines and some corporate flight departments that do so.

Cat III ILS, which includes subcategories **a**, **b**, and **c**, is in a class all its own. Cat IIIa approaches may be flown to a 50-foot DH, with RVR as low as 700 feet. The minima enables the crew to perform a safe missed approach, having fail passive equipment installed. Cat IIIb minimums go even lower — down to 300 feet RVR, using fail operate equipment and depending on the operator's particular level of authorization. Cat IIIc approaches, which are not yet authorized and for which no aircraft is yet certified in the USA, would have no RVR limitation — the first true completely "blind" approach and landing procedure. One problem yet to be resolved is how to safely maneuver the aircraft on the taxiways after landing when no outside visual reference exists. One problem under these visibility conditions is the inability to safely taxi the aircraft.

Cat I and II ILS procedures differ from those of Cat IIIa in one important respect. They require that the crew visually spot the approach lights — and, eventually, other runway environment cues — in order to safely continue to a **landing by visual reference alone**. In other words, the landing pilot must be able to properly judge the flare point, make the landing, and execute the rollout visually.

Cat IIIa approaches, on the other hand, merely require that the pilot establish sufficient visual reference with the touchdown zone lights to **ensure that landing is occurring in the touchdown zone**. The pilot may never even see the approach lights. Visual reference may be such that the pilot is unable to properly judge the flare point or manually control the aircraft during the initial rollout. The autopilot will normally execute the flare, landing, and

rollout down to taxi speed. (In certain HUD-equipped aircraft, Cat IIIa approaches can be hand flown without an autopilot. The HUD provides maneuvering cues that are sufficient to guide the pilot through the flare, landing, and rollout.)

Cat IIIb autolandings — the lowest currently certified — may occur before any visual reference with the runway is established by the pilot. Since there is no "decision" to be made based on visibility, the approaches employ an alert height (AH) instead of a DH. The AH is merely a point above which a failure in certain required airborne or ground equipment mandates a missed approach. If the equipment failure occurs below the AH, the flare, touchdown, and rollout can still be safely accomplished by using redundant Cat III autoland components. Rather than using outside cues to ensure that landing is occurring in the touchdown zone, the crew may verify this by using onboard instrumentation and warning systems.

General Equipment Requirements

Since the autopilot is important aid in a typical Cat III approach and landing, it's no surprise that it needs to perform to exacting standards. For certification purposes, it must be capable of autolanding throughout the full range of aircraft weight and center of gravity limits. It has to handle moderate turbulence, headwinds of up to 25 knots, tailwinds of 10 knots, and crosswinds of 15 knots. (Most operators observe more conservative Cat III wind limitations.) It must compensate for wind shears of up to 8 knots per 100 feet of altitude change in the critical last 200 feet before touchdown. It also should consistently land very close to, or on, the runway centerline, and in the touchdown zone. Throughout the approach and landing it must continuously provide the crew with "conspicuous and unmistakable" feedback that it is operating within tolerances.

Depending upon the autoland system's degree of redundancy, it is described as being either a fail operational or a fail passive Cat III system. Fail operational systems are sufficiently redundant to allow a safe continuation of the approach and autolanding, following certain equipment failures below AH. Fail passive systems do not have such redundancy. They are restricted to Cat IIIa approaches having a 50-foot DH. At DH, the pilot must be able to verify that the autolanding will occur in the touchdown zone. If an onboard equipment failure prevents this verification, a missed approach must be made.

Flying Technique and Crew Coordination

Cat I or II approaches may be flown single pilot in aircraft with the appropriate equipment. The Cat III approach is a team effort, however, always played with a complete flight crew. It requires use of **"monitored approach"** procedures. These are designed to ease the flight crew's transition from IMC conditions to visual control of the aircraft at some point during the approach, landing, or rollout. (Monitored approach procedures are not reserved solely for Cat III operations. Many airlines mandate their use during all ILS approaches whenever visibility is at or near minimums.)

During a monitored approach, the first officer normally controls the aircraft on autopilot. The captain, meanwhile, makes required altitude call-outs and "monitors" aircraft and systems performance. Approaching DH (Cat I, II, or IIIa), the captain prepares to take control of the aircraft by looking outside. The first officer's attention remains on the gauges. This allows the captain time to acclimate to the view outside before actually taking over. If the captain has not assumed control upon reaching DH, the first officer announces "Minimums, going around" and initiates the missed approach. (These procedures

are modified slightly for Cat IIIb approaches using an AH.) A go-around is mandated if the aircraft exceeds any one of numerous performance parameters within the so-called "decision regime," from 500 feet agl until flaring. These include airspeed deviations of 5 knots or more, localizer deviations greater than one-third dot, most instrument warning flags, a ground proximity warning system activation, or a stabilized crab angle of 10 degrees or more (indicating an excessive crosswind).

Such exacting procedures and limitations are what make very low-visibility Cat III autolandings routinely possible.

Figure 1

Categories of ILS Approaches.

Category	DH	RVR	Remarks
I	200 feet	2400 feet	
I	200 feet	1800 feet	With touchdown zone and runway centerline lighting .
II	100 feet	1200 feet	Half the minimums of a standard Cat I approach
IIIa	below 100 feet	700 feet	
IIIb	below 50 feet	less than 700 feet but not less than 150 feet	
IIIc	No DH	No RVR limitation	Pray that your electronics and autopilot are reliable.

Data from Aeronautical Information Manual, *AIM*.

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