



BY HANS HOUTMAN

Never Cross **RED**

Exceptions to a global rule weaken the effectiveness of the stop bar as a last defense against runway incursions.

Hindsight is always an advantage in assessing how an airport surface movement guidance and control system (SMGCS) can be improved. The object is not to dwell on the past but to start an informed discussion about more effectively preventing runway incursions. A current case in point is the stop bar, a deceptively simple safety concept. We all believe in the power of a red traffic light when driving to work. Red is red, and we stop.

The International Civil Aviation Organization (ICAO) in 1958 began to publish guidance on the use of the stop bar. A stop bar is one row of flush-mounted unidirectional red

lights installed across a taxiway with 3-m (10-ft) spacing to designate a runway-holding position or intersection/taxiway-holding position. It is operated by air traffic services and, when lighted, shows where air traffic control (ATC) requires that aircraft and vehicles stop.

ICAO specifications also call for green taxiway centerline lead-on lights to be extinguished for at least 90 m (295 ft) beyond a lighted stop bar, commonly called a “red” stop bar (Figure 1, p. 28). When ATC issues a clearance to proceed, the controller turns off the red lights and the section of interlocked lead-on lights illuminates showing the taxi route to the runway.

After an aircraft/vehicle crosses the stop bar, all lights are reset manually or automatically.

Investigations of European runway incursions suggest that a few safety issues involving stop bar implementations and human errors need a fresh look:

- Controllers in some states routinely instruct pilots and others to cross red stop bars; in other states, pilots are prohibited from crossing a red stop bar even if cleared by ATC to proceed beyond the stop bar. Elsewhere, pilots are permitted to cross a red stop bar with ATC clearance if ATC provides an escort vehicle and/or the

Simple Sequence in Stop Bar Concept

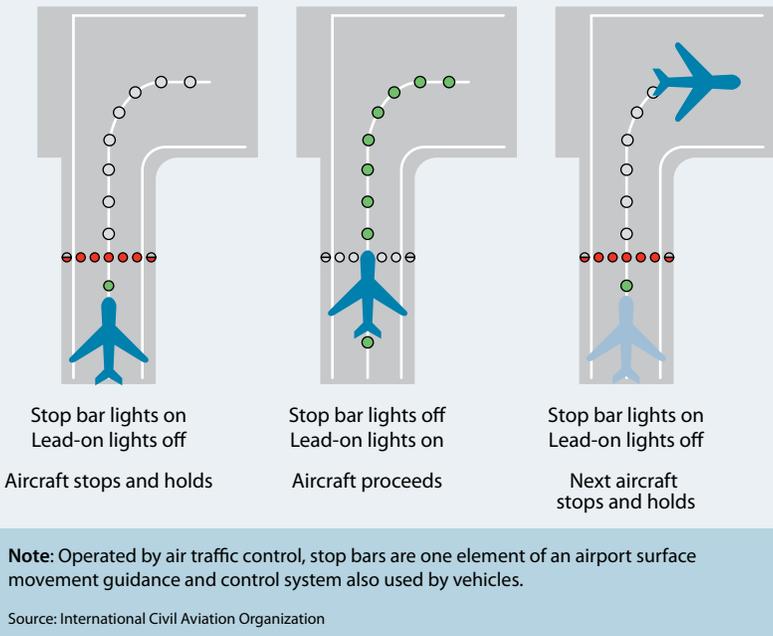


Figure 1

Preventing the crossing of a red stop bar has proven difficult.

clearance explicitly notes that crossing the red stop bar is a one-time exception to the rule because of a stop bar failure;

- In some runway incursions, ATC has directed pilots' attention to traffic on or in the vicinity of the runway while issuing a conditional taxi clearance, which allows the cleared aircraft to taxi only after another action, such as passage of another aircraft, has occurred. During this distraction, pilots forgot or otherwise failed to comply with the red stop bar; and,
- In other runway incursions, pilots failed to see a red stop bar because the cut-off viewing angle of the cockpit obstructed their forward view.

Civil aviation authorities typically report the crossing of a red stop bar as a runway incursion because an ATC clearance to proceed is not sufficient: according to ICAO Annex 2, *Rules of the Air*, a pilot needs an ATC clearance *and* the red lights have to be extinguished.^{1,2} Preventing the crossing of a red stop bar has proven difficult.

Safety professionals therefore should heed the lessons of history, such as the records from 1964 to 1980 of the ICAO Visual Aids Panel (VAP) and runway-incursion investigations in this decade.³

In 1964, early stop bars were used in conjunction with centerline lighting control. They primarily obviated the need for radio communication of some ATC taxi instructions; they also could be used to regulate the flow of traffic entering a runway or through a taxiway intersection. In 1970, ICAO standards required that markings for a runway-holding position near a Category II instrument landing system (ILS) be provided wherever necessary to hold aircraft or vehicles farther from the runway to avoid interference with radio navigation aids. One of the exceptions was that stop bars fulfilled the requirement for marking this position if under the control of air traffic services.

In 1972, use of the stop bar increased to supplement/replace markings when appropriate for poor visibility conditions. The VAP discussed numerous instances in which pilots were unaware of the guidance available from visual aids. Researchers also were experimenting with a variation: Elevated lights called "wing bars" were added on the sides of the taxiway to provide deceleration guidance to aircraft approaching the stop bar, and to enable pilots to identify more accurately their position in relation to the stop bar. In 1976, signs were recommended to make a runway-holding position with a stop bar more conspicuous.

In 1978, the cockpit cut-off viewing angles of some types of aircraft were found to influence pilot compliance. Some pilots could not see the stop bar when the aircraft was near it — about 23 m (75 ft) in the case of the Boeing 747, for example — so the aircraft could not be slowed sufficiently to stop where required. Some of those aircraft encroached on another taxiway or runway. The VAP aimed to make the stop bar more visible and, if possible, to develop alternate procedures. Elevated red lights at each end of a stop bar also proved necessary at some runway-holding positions, irrespective of the aircraft

type, if the stop bar might be obscured by snow or rain. The VAP also decided that pairs of these elevated lights should be provided, in case one should fail, and that each side of the taxiway should have a pair so that the pilot, the copilot or both could see the signal.

In 1980, the VAP wanted failure of all stop bar lights to be preventable by design of the electrical circuits. Some members of the VAP pointed out that the existing stop bar concept could be unsatisfactory in low-visibility conditions. This revived discussion of whether the “go” signal would be made more effective by illuminating a row of green lights. Proponents of green lights said that under conditions of poor visibility or power failure, a pilot could misinterpret the disappearance of the red lights as the go signal. They said green lights would be a safer, more positive go signal. They argued that tests had shown that red for stop/green for go was useful and did not increase controller workload.

Proponents of keeping the existing red-only method argued that experience with the stop bar was still limited, so it would be premature to consider adding green lights; that the existing stop bar concept had not been proven inadequate/unsafe; and that green lights likely would introduce problems such as increased controller workload.

In a 1980 meeting, the VAP heard that traffic in one state was required by ATC instructions to cross the red stop bar. The air traffic services provider argued that it was safer to leave the stop bar lighted at all times because busy controllers might forget to manually turn on the stop bar for the next aircraft or vehicle. In another state, controllers reportedly did not want to operate the stop bars that had been installed, so the red filters covering lights were changed to yellow.

The VAP’s response was unanimous: Keeping stop bars continuously red and routinely instructing traffic to cross a red bar is detrimental to safety. Such practices, even in one state, weaken the entire concept. The signal could have only one meaning: Do not cross a red stop bar. Amendments during the next 28 years refined the basic concept. In the early 1980s, for example, airports began following ICAO’s

recommendation to add yellow, alternately illuminated taxi-holding position lights on each side of a stop bar. In 2002, the VAP recommended broader implementation of stop bars as a runway-incursion countermeasure.

In summary, use of stop bars in a nonstandard manner could lead to confusion and possibly to accidents. Flight crews might be operating in an airport-ATC environment with the strict rule not to cross any red stop bar, even if ATC clears the aircraft to line up on the runway. An hour and a half later, the same flight crew might be operating on an airport where they are required by controllers to cross a red stop bar.

ATC in all states should adhere to ICAO standards and recommended practices for stop bars. Pilots use more than one airport. Pilots may operate in more than one country. It is in everyone’s interest to use just one method: Red is red, so we stop. ➔

Hans Houtman is coordinator-investigator, Incident Investigation, ATC The Netherlands.

Notes

1. The equipment and required/recommended applications are described in Annex 14, Volume I, *Aerodrome Design and Operations*, section 5.3.19, “Stop Bars,” and in paragraph 9.8.6.
2. Annex 2, paragraph 3.2.2.7.3 contains related procedures for controllers, pilots and drivers, including, “An aircraft taxiing on the maneuvering area shall stop and hold at all lighted stop bars and may proceed further when the lights are switched off.”
3. One example cited in European runway-safety presentations is one of two airproxes on Nov. 23, 2002, at Zurich Airport. The Federal Aircraft Accident Board of Switzerland said that the crew of an Air France Boeing 737 crossed both a red stop bar and Runway 24 during the takeoff by a Swiss Saab 2000 on the same runway, and the Saab overflew the 737 at a height of 40 to 50 m (131 to 164 ft). The board cited in part the 737 crew’s “lack of concentration during a taxiing procedure” and failure “to monitor their taxiing route continuously.” The position of the sun behind the 737 was noted. Safety recommendations included high-priority implementation of a subsystem in an advanced SMGCS to provide visual and audible alerts of stop bar violations on air traffic controller workstation displays.