



U.S. Department
of Transportation
**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

JAN 26 2015

Mr. Tjibbe Joustra
Chairman
Onderzoeksraad Voor
Veiligheid
Postbus 95404
2509 CK Den Haag

Dear Mr. Joustra:

This is the initial response to safety recommendations issued to the Federal Aviation Administration (FAA) on June 26, 2014, by the Onderzoeksraad Voor Veiligheid (Dutch Safety Board).

The Dutch Safety Board issued these safety recommendations following its investigation of an incident that occurred at Eindhoven Airport. On May 31, 2013, a Ryanair Boeing 737 was radar vectored to runway 21 for a landing with the aid of the Instrument Landing System. The aircraft was flying under Instrument Meteorological Conditions. During the latter stage of the approach, the aircraft was above the intended 3 degree Glide Path. After the Localizer was captured, a Glide Slope intercept from above caused a nose pitch increase of 24.5 degrees. The crew made a successful go around and landed at Eindhoven Airport.

14.117. Ensure that False Glide Slope characteristics and possible associated consequences are widely known and modified accordingly in published manuals and training materials for the area above and below the published or nominated ILS Glide Path.

14.118. Ensure that False Glide Slope characteristics and possible associated consequences are widely known and modified accordingly in published manuals and training materials for the absence of warnings in the cockpit when flying with the automatic flight systems engaged in the area above the published or nominal ILS Glide Path.

14.119. Ensure with oversight that aviation operators, manufacturers, and Air Navigation Service Providers take mitigating actions to prevent pitch-up upsets due to aircraft exposure to False Glide Slope Reversal as a result of flying with the automatic flight systems engaged in the area above the published or nominated ILS Glide Path by raising the interception of the ILS Glide Slope from below to a standard, or in the event of an interception from above.

14.120. Ensure with oversight that aviation operators, manufacturers, and Air Navigation Service Providers take mitigating actions to prevent pitch-up upsets due to aircraft exposure to

False Glide Slope Reversal as a result of flying with the automatic flight systems engaged in the area above the published or nominated ILS Glide Path by developing additional operating procedures.

14.121. Automated on-board systems when in use should not cause a pitch-up upset, at least not without a preceding clearly recognizable warning and with ample time for flight crew intervention.

14.122. Stimulate manufacturers to develop new landing systems to accommodate new approaches for aircraft with automatic flight systems engaged and ensure that airports are equipped with these landing systems.

FAA Comment. The FAA is evaluating these recommendations to determine the best course of action. We expect to provide your office with an updated response by May 31, 2015.

14.123. Assess the aviation Safety Management System occurrence reporting and analyses methodology, including the use of the existing ECCAIRS databases on the levels (operator, Air Navigation Service Provider, manufacturer, national-international level) whether measures are required to achieve the goal of the system to identify potential safety deficiencies in a timely manner. The review should also take into account: (a) the possibility to add internal investigation results into the ECCAIRS databases (feedback-loop), (b) the necessity to exchange investigation information with the manufacturer.

FAA Comment. The FAA aims to use existing safety databases to identify and treat emerging hazards by developing a process for identifying Significant Safety Issues (SSIs) through leveraging the efforts of Aviation Safety Information Analysis and Sharing, Commercial Aviation Safety Team, General Aviation Joint Steering Committee, International Helicopter Safety Team, and other data sources. The development of SSIs is a two-tier system that includes multiple FAA Lines of Business (LOB). Each individual LOB is tasked with developing a list of SSIs. The individual LOB SSI lists will then be compiled into an SSI list for the FAA level. The items on that list that cross organizational boundaries will be identified and prioritized. To date, a representative from each LOB has been identified and the team has met twice to outline the work plan for developing the necessary processes. The LOB level SSI identification process is to be developed by March 31, 2015. The FAA-level SSI list development date will be determined once the LOB list is completed. We expect to provide an update on our progress by May 31, 2015.

14.124. Review the applicable regulations on initial and recurrent flight crew training to assess whether they adequately address the potential degradation of situational awareness (basic pilot skills) and flight path management due to increased reliance on aircraft automation by flight crews.

FAA Comment. The FAA's Flight Standards Service, Air Carrier Training Systems and Voluntary Safety Program, is evaluating this recommendation to determine the best course of action. We expect to provide your office with an updated response by May 31, 2015.

The FAA would like to thank the Dutch Safety Board for submitting FAA Safety Recommendations 14.117 through 14.124 and its continued interest in aviation safety. If you have any questions, or need additional information regarding these safety recommendations, please contact the FAA Safety Recommendations Program staff at 9-AVP-FAA-SafetyRecs@faa.gov. Alternatively, you may contact Mr. Rolf Brockmeyer, AVP-420, at (202) 267-2706.

Sincerely,

A handwritten signature in black ink, appearing to read 'W. Griffin', with a horizontal line extending to the right.

Wendell Griffin
Director, Office of Accident Investigation
And Prevention



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of Transportation
**Federal Aviation
Administration**

800 Independence Ave., S.W.
Washington, D.C. 20591

JUL 6 2015

Mr. Tjibbe Joustra
Chairman
Onderzoeksraad Voor
Veiligheid
Postbus 95404
2509 CK Den Haag

Dear Mr. Joustra:

This is the final response to Safety Recommendation 14.124 issued to the Federal Aviation Administration (FAA) on June 26, 2014, by the Onderzoeksraad Voor Veiligheid (Dutch Safety Board). The Dutch Safety Board issued this safety recommendation following its investigation of an incident that occurred at Eindhoven Airport, the Netherlands. On May 31, 2013, a Ryanair Boeing 737-800 was radar vectored to runway 21 for a landing with the aid of the Instrument Landing System (ILS). The aircraft was flying under Instrument Meteorological Conditions. During the latter stage of the approach, the aircraft was above the intended 3 degree Glide Path. After the Localizer was captured, a Glide Slope intercept from above caused a nose pitch increase of 24.5 degrees. The crew made a successful go around and landed at Eindhoven Airport.

14.124. Review the applicable regulations on initial and recurrent flight crew training to assess whether they adequately address the potential degradation of situational awareness (basic pilot skills) and flight path management due to increased reliance on aircraft automation by flight crews.

FAA Comment. After careful consideration and review, the FAA has determined that our current policy and regulatory requirements with regards to the procedures in flying precision approaches is adequate in addressing false glideslopes. Pilots are trained, checked, and evaluated according to FAA standards, which include the acceptable requirements and criteria in flying a precision approach. This includes monitoring both the glideslope (vertical) and localizer (lateral) to maintain within FAA standards. Additionally, the pilots are responsible for ensuring that the correct procedure is briefed, tuned, identified, and monitored. Pilots are also responsible for executing the proper procedures and maneuvers if a system malfunction occurs or when a portion of the procedure is allowed to deviate outside of the established standards as published in FAA or operator policy as approved by the FAA.

I believe that the FAA has effectively addressed this safety recommendation and consider our actions complete.

The FAA would like to thank the Dutch Safety Board for submitting FAA Safety Recommendation 14.124 and its continued interest in aviation safety. If you have any questions, or need additional information regarding this safety recommendation, please contact the FAA Safety Recommendations Program staff at 9-AVP-FAA-SafetyRecs@faa.gov. Alternatively, you may contact Mr. Rolf Brockmeyer, AVP-420, at (202) 267-3706.

Sincerely,



for - Wendell Griffin
Director, Office of Accident Investigation
And Prevention



U.S. Department
of Transportation
**Federal Aviation
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DE ONDERZOEKRAAD VOOR VEILIGHEID

800 Independence Ave., S.W.
Washington, D.C. 20591

Mr. Tjibbe Joustra
Chairman
Onderzoeksraad Voor
Veiligheid
Postbus 95404
2509 CK Den Haag
Netherlands

Dear Mr. Joustra:

This is in further response to Safety Recommendation 14.123 issued to the Federal Aviation Administration (FAA) on June 26, 2014, by the Onderzoeksraad Voor Veiligheid (Dutch Safety Board). The Dutch Safety Board issued this safety recommendation following its investigation of an incident that occurred at Eindhoven Airport, the Netherlands. On May 31, 2013, a Ryanair Boeing 737-800 was radar vectored to runway 21 for a landing with the aid of the Instrument Landing System. The aircraft was flying under Instrument Meteorological Conditions. During the latter stage of the approach, the aircraft was above the intended 3 degree Glide Path. After the Localizer was captured, a Glide Slope intercept from above caused a nose pitch increase of 24.5 degrees. The crew made a successful go around and landed at Eindhoven Airport.

14.123. Assess the aviation Safety Management System occurrence reporting and analyses methodology, including the use of the existing ECCAIRS databases on the levels (operator, Air Navigation Service Provider, manufacturer, national-international level) whether measures are required to achieve the goal of the system to identify potential safety deficiencies in a timely manner. The review should also take into account: (a) the possibility to add internal investigation results into the ECCAIRS databases (feedback-loop), (b) the necessity to exchange investigation information with the manufacturer.

FAA Comment. The FAA-level Significant Safety Issue (SSI) identification processes have been reviewed and briefed to the FAA Safety Management System Executive Council. The cross-organizational items submitted from each FAA line of business (LOB) SSI list have been prioritized using the FAA SSI Identification process. Items from the LOB SSI lists that do not cross LOBs are being treated within the respective LOBs. When appropriate, a manufacturer can be involved as a stakeholder in a safety analysis. The process for updating the SSI list is planned to be repeated annually, with modifications made to optimize the process using lessons learned in each iteration.

The FAA does not use European Coordination Centre for Accident and Incident Reporting (ECCAIRS) but utilizes many databases, including the Hazard Identification, Risk

Management & Tracking Capability, which is planned to become fully operational in 2016. This system will help track progress and results, and provide a feedback loop through documenting investigation results. As previously noted, the SSI list process will be repeated annually, which will then generate the feedback loop.

I expect to provide an updated response to this safety recommendation by September 2016.

The FAA would like to thank the Dutch Safety Board for submitting FAA Safety Recommendation 14.123 and its continued interest in aviation safety. If you have any questions, or need additional information regarding this safety recommendation, please contact the FAA Safety Recommendations Program staff at 9-AVP-FAA-SafetyRecs@faa.gov. Alternatively, you may contact Mr. Rolf Brockmeyer, AVP-420, at (202) 267-3706.

Sincerely,



WGR - Wendell Griffin
Director, Office of Accident Investigation
and Prevention



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SEP 15 2015

Mr. Tjibbe Joustra
Chairman
Onderzoeksraad Voor
Veiligheid
Postbus 95404
2509 CK Den Haag

Dear Mr. Joustra:

This is in further response to Federal Aviation Administration (FAA) Safety Recommendations 14.117 through 14.122 issued by the Onderzoeksraad Voor Veiligheid (Dutch Safety Board) on June 26, 2014. The Dutch Safety Board issued these safety recommendations following its investigation of an incident that occurred at Eindhoven Airport, the Netherlands. On May 31, 2013, a Ryanair Boeing 737-800 (B 737) was radar vectored to runway 21 for a landing with the aid of the instrument landing system (ILS). The aircraft was flying under instrument meteorological conditions. During the latter stage of the approach, the aircraft was above the intended 3 degree glide path. After the localizer was captured, a glide slope (GS) intercept from above caused a nose pitch increase of 24.5 degrees. The crew made a successful go around and landed at Eindhoven Airport.

14.117. Ensure that False Glide Slope characteristics and possible associated consequences are widely known and modified accordingly in published manuals and training materials for the area above and below the published or nominated ILS Glide Path.

14.118. Ensure that False Glide Slope characteristics and possible associated consequences are widely known and modified accordingly in published manuals and training materials for the absence of warnings in the cockpit when flying with the automatic flight systems engaged in the area above the published or nominal ILS Glide Path.

FAA Comment. As a result of the Eindhoven incident, Boeing updated the B 737-NG and 737-CL Flight Crew Training Manuals (FCTMs) to capture additional false GS characteristics, specifically the consequences of capturing a signal reversal false GS on their B 737 airplanes. The FCTMs now reflect that under some circumstances a pitch-up command may occur when attempting to intercept the GS from above. The FCTM note states:

“In some instances, when intercepting the G/S from well above a 3° G/S, a false G/S capture can result in an unexpected rapid pitch-up command which can lead to a rapid loss of airspeed.”

The B 747, 757, 767, 777, and 787 were evaluated and the FCTMs were not updated because autoflight simulation has shown that these models are not susceptible to the pitch-up phenomenon. The GS capture logic is different and will not allow capture of a signal reversal false GS beam.

During the Eindhoven incident, the flightcrew had multiple indications that the altitude range-distance relationship was abnormal, including altimeters, distance measuring equipment distances, and the vertical situation display. The recorded GS deviation showed over 2 dots deviation for the duration of the approach until approximately 1.5 nautical miles. The deviation was not decreasing as the approach continued, as it would on a normal approach course. Recommended elements of a stabilized approach per the Boeing FCTM include flying an ILS approach within 1 dot of the GS.

Also, regarding warnings in the cockpit, Boeing aircraft do not set a warning before the aircraft crosses or receives a false GS. However, on some Boeing aircraft, when the GS mode is engaged and the autopilot is commanding the aircraft to intersect the GS beam, the autopilot may detect that the GS beam is inconsistent with the inertial data and flag the anomaly. This anomaly detection is not directly annunciated to the flightcrew, but will annunciate as either an autopilot disconnect or as an autopilot mode fail flag (autopilot caution message) depending on the configuration and type of aircraft, if the anomaly flag remains true for a set duration. In the Eindhoven incident, the autopilot was disengaged prior to the time that autopilot disconnect would have occurred.

As noted in the Dutch Safety Board report, “Pitch-up Upsets due to ILS False Glide Slope,” the Boeing FCTMs already included additional false GS information related to detection, guidance, and techniques including instructions to verify the position of the aircraft relative to the runway. Flightcrew following this guidance and monitoring the descent profile using the information provided above, should be able to determine the position of the aircraft and assess whether it is appropriate for intercepting the normal 3 degree GS.

In addition to manufacturer provided manuals and training, as the Dutch Safety Board report indicates, the FAA provides some characteristics of false GSs in FAA-H-8083-15B, “Instrument Flying Handbook,” which states with respect to ILS errors:

False courses. In addition to the desired course, GS facilities inherently produce additional courses at higher vertical angles. The angle of the lowest of these false courses occurs at approximately 9°– 12°. An aircraft flying the localizer [LOC]/GS course at a constant altitude would observe gyrations of both the GS needle and GS warning flag as the aircraft passed through the various false courses. Getting established on one of these false courses results in either confusion (reversed GS needle indications) or in the need for a very high descent rate. However, if the approach is conducted at the altitudes specified on the appropriate approach chart, these false courses are not encountered.

However, as the Dutch Safety Board points out, this description may not be completely accurate for all ILS GS antenna types and for all airplane systems and autoflight responses. For example, for some ILS GS antenna types, there can also be a false GS at approximately 6 degrees and for some airplanes there may be different indications provided when approaching a false GS and different autoflight responses when capturing a false GS (e.g. a pitch-up command).

The FAA also provides procedures to avoid or prevent capturing a false GS in FAA-H-8083-16, "Instrument Procedures Handbook," which states:

The glideslope intercept altitude of a precision approach should also be included in the IAP [instrument approach procedure] briefing. Awareness of this altitude when intercepting the glideslope can ensure the flight crew that a "false glideslope" or other erroneous indication is not inadvertently followed. Many air carriers include a standard callout when the aircraft passes over the FAF [final approach fix] of the non-precision approach underlying the ILS. The PM [pilot monitoring] states the name of the fix and the charted glideslope altitude, thus allowing both pilots to cross-check their respective altimeters and verify the correct indications... Selecting approach [APP] once the aircraft has leveled at the FAF altitude is a suggested technique to ensure that the airplane captures the glideslope from below and that a false glideslope is not being tracked.

Also, the "Aeronautical Information Manual Official Guide to Basic Flight Information and ATC Procedures," provides a more general warning and description of false GSs stating that:

"Pilots must be alert when approaching the glidepath interception. False courses and reverse sensing will occur at angles considerably greater than the published path."

The FAA manuals cited above, although not mandated, are publicly available and can be used by the manufacturer or the operator in developing their operations, training, or other similar manuals. The operators' manuals are ultimately approved by the FAA Principal Operations Inspector, and therefore, these procedures do tend to be common in most operators' manuals. However, regarding the false GS information provided in the "Instrument Flying Handbook," pilot training typically focuses on procedures (e.g. stabilized approach procedures to prevent intercepting a false GS) and includes less theory (characteristics or causes of false GSs).

Based on this information, we will continue to evaluate false GS information, specifically characteristics and consequences, provided in published manuals and training materials, as well as warnings (or lack thereof) provided to the flightcrew. Although there appears to be an acceptable amount of information provided in manufacturer, operator, and regulatory manuals, we will evaluate the information provided in the FAA's "Instrument Procedures Handbook" for clarity and accuracy of the representation of all ILS GS antennas, airplane indications, or autoflight responses. However, it may be more appropriate to capture airplane indications and autoflight responses in manufacturer or operator provided manuals, while ILS GS characteristics could be better addressed in an FAA manual available to the entire aviation community. We will work with other manufacturers, FAA Flight Standards and Air Traffic Organization to make any necessary improvements to the appropriate manual(s) regarding false GS characteristics and consequences.

14.119. Ensure with oversight that aviation operators, manufacturers, and Air Navigation Service Providers take mitigating actions to prevent pitch-up upsets due to aircraft exposure to False Glide Slope Reversal as a result of flying with the automatic flight systems engaged in the area above the published or nominated ILS Glide Path by raising the interception of the ILS Glide Slope from below to a standard, or in the event of an interception from above.

14.120. Ensure with oversight that aviation operators, manufacturers, and Air Navigation Service Providers take mitigating actions to prevent pitch-up upsets due to aircraft exposure to False Glide Slope Reversal as a result of flying with the automatic flight systems engaged in the area above the published or nominated ILS Glide Path by developing additional operating procedures.

FAA Comment. As stated in the Dutch Safety Board report, ICAO Document 4444, "Procedures for Air Navigation Services - Air Traffic Management, PANS-ATM," Section 8.9.3.6 recommends interception of the ILS GS from below, and based on our investigation it appears most operators' operating procedures and training do specify to capture the GS from below since intercepting the GS from above is a warning of a non-stabilized approach.

Boeing's (and other manufacturers') FCTMs or Flight Crew Operating Manuals provide a recommended technique for intercepting the GS from above during an ILS approach. However, during the Eindhoven incident and other events, the recommended technique was not used.

Our FAA Aircraft Evaluation Group, working with many major airline operators in the United States, indicated that they are not aware of any airline that teaches GS capture from above, and stated that capturing the GS from below is the norm and complies with standard stabilized approach procedures. However, they are aware of times when capturing the GS from above has occurred such as following short ATC vectoring (as was the case in the Eindhoven incident) or due to weather conditions (also a contributing factor in this event), but that ultimately joining the ILS from above the GS is not recommended, and requires extra vigilance by the crew to capture stabilized approach criteria. They also believe the concept of false GSs has become well known and consequently crew procedures have continually been adapted to capture additional information to mitigate these events through strict adherence to stabilized approach standards. They stated the procedures illustrated in the "Instrument Procedures Handbook" cited above, are very much the standard in commercial airlines.

Based on this information, we will continue to evaluate these recommendations to assess whether there is any safety benefit to additional operating procedures given the training and procedures already in place to prevent GS captures from above (thereby reducing the likelihood of false GS captures), taking into account the improvements Boeing, and other manufacturers may be doing, to reduce the severity or consequences of a false GS capture (e.g. software updates to prevent a pitch-up).

14.121. Automated on-board systems when in use should not cause a pitch-up upset, at least not without a preceding clearly recognizable warning and with ample time for flight crew intervention.

FAA Comment. The B 737-NG Rockwell Collins Flight Control Computer (FCC) software has been updated to include a change, which will prevent a pitch-up command upon capture of a false GS. Boeing incorporated this software change into production for the B 737-NG fleet in January 2015. A service letter was also sent to operators to inform them that the new FCC software was available for retrofit. In response to the Eindhoven incident, the FAA Seattle Aircraft Certification Office, Flight Test Branch, conducted an analysis to evaluate the risk using the safety determination methodology per FAA Order 8110.107, Monitor Safety/Analyze Data, and FAA Policy Statement PS-ANM-25-05, Risk Assessment Methodology for Transport Category Airplanes. The exposure and outcome associated with this event did not meet the criteria for an unsafe condition according to our guidance. Therefore, an airworthiness directive with subsequent mandatory retrofit of the fleet is not supported.

Boeing has shown that the B 747, 757, 767, 777, and 787 are not susceptible to this pitch-up command due to a difference in GS capture and anomaly detection logic that prevents capture of a signal reversal false GS beam.

Finally, for B 737-CL, B 737-NG, and other Boeing airplanes, there are annunciations, recommended cross checks and information in the flight deck that are available to the flightcrew and would provide sufficient information to identify abnormal conditions that may result from attempting to intercept a false GS.

Based on this information, we will continue to investigate other manufacturers' autoflight response to, and annunciation of, signal reversal false GS captures to determine whether similar mitigations are feasible or necessary.

14.122. Stimulate manufacturers to develop new landing systems to accommodate new approaches for aircraft with automatic flight systems engaged and ensure that airports are equipped with these landing systems.

FAA Comment. Global Navigation Satellite System (GNSS)-based approaches are becoming widely adopted. Specifically for precision approaches, the aviation industry has developed a positioning and landing system based on GNSS known as the GNSS landing system (GLS). GLS integrates satellite and ground-based navigation information to provide extremely accurate and stable position information for approach and landing guidance when compared with the current ILS system. There is no beam bending, no FM frequency interference, no interference from preceding aircraft, no ground areas near the runway that need to be protected from surface traffic, and most importantly for this discussion, it is not vulnerable to false GS signals inherent in the ILS system. GLS approach procedures and techniques are identical to those of an ILS approach. GLS approaches have been certified to Category I approach minimums and have also been demonstrated through autoland and rollout. GLS capability is standard on B 747-8, and B 787 aircraft and is an option on B 737-NG, Airbus A320, A330/340, and A380 aircraft. Category II/III capability is in development and expected to be available in 2017.

I expect to provide an updated response to these safety recommendations by July 31, 2016.

The FAA would like to thank the Dutch Safety Board for submitting FAA Safety Recommendations 14.117 through 14.122 and its continued interest in aviation safety. If you have any questions, or need additional information regarding these safety recommendations, please contact the FAA Safety Recommendations Program staff at 9-AVP-FAA-SafetyRecs@faa.gov. Alternatively, you may contact Mr. Rolf Brockmeyer, AVP-420, at (202) 267-3706.

Sincerely,



W - Wendell Griffin
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