



[4910-13]

**DEPARTMENT OF TRANSPORTATION**

**Federal Aviation Administration**

**14 CFR Part 29**

**[Docket No. FAA-2020-0756; Special Conditions No. 29-050-SC]**

**Special Conditions: Leonardo S.p.A. (Leonardo) Model AW189, Search and Rescue (SAR)**

**Automatic Flight Control System (AFCS)**

**AGENCY:** Federal Aviation Administration (FAA), DOT.

**ACTION:** Final special conditions; request for comments.

**SUMMARY:** These special conditions are issued for the Leonardo Model AW189 helicopters.

This model of helicopter, as modified by Leonardo, will have the novel or unusual design feature associated with installing an optional SAR AFCS. The applicable airworthiness standards do not contain adequate or appropriate safety standards for this design feature. These special conditions contain the additional safety standards that the Administrator considers necessary to show a level of safety equivalent to that established by the existing airworthiness standards.

**DATES:** The effective date of these special conditions is [INSERT DATE 15 DAYS AFTER PUBLICATION IN THE FEDERAL REGISTER]. The FAA must receive your comments by [INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].

**ADDRESSES:** Send comments identified by docket number FAA-2020-0756 using any of the following methods:

- Federal eRegulations Portal: Go to <http://www.regulations.gov> and follow the online instructions for sending your comments electronically.

- Mail: Send comments to Docket Operations, M-30, U.S. Department of Transportation (DOT), 1200 New Jersey Avenue, SE, Room W12-140, West Building Ground Floor, Washington, DC 20590-0001.
- Hand Delivery of Courier: Take comments to Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE, Washington, DC, between 9 a.m., and 5 p.m., Monday through Friday, except Federal holidays.
- Fax: Fax comments to Docket Operations at 202-493-2251.

Privacy: The FAA will post all comments it receives, without change, to <http://regulations.gov>, including any personal information the commenter provides. Using the search function of the docket web site, anyone can find and read the electronic form of all comments received into any FAA docket, including the name of the individual sending the comment (or signing the comment for an association, business, labor union, etc.). DOT's complete Privacy Act Statement can be found in the *Federal Register* published on April 11, 2000 (65 FR 19477-19478), as well as at <http://DocketsInfo.dot.gov>.

Docket: Background documents or comments received may be read at <http://www.regulations.gov> at any time. Follow the online instructions for accessing the docket or go to the Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE, Washington, DC, between 9 a.m., and 5 p.m., Monday through Friday, except Federal holidays.

**FOR FURTHER INFORMATION CONTACT:** FAA, Mr. Mitchell Soth (AIR-713), Regulations and Policy Section, AIR-681, Rotorcraft Standards Branch, Policy & Innovation Division, Aircraft Certification Service, 10101 Hillwood Parkway, Fort Worth, Texas 76177; telephone (817) 222-5104; facsimile (817) 222-5961.

## **SUPPLEMENTARY INFORMATION:**

### **Reason for No Prior Notice and Comment Before Adoption**

The FAA has determined, in accordance with 5 U.S. Code 553(b)(3)(B) and 553(d)(3), that notice and opportunity for prior public comment hereon are unnecessary because substantially identical special conditions have been previously subject to the public comment process in several prior instances such that the FAA is satisfied that new comments are unlikely. For the same reason, the FAA finds that good cause exists for adopting these special conditions upon issuance. The FAA is requesting comments to allow interested persons to submit views that may not have been submitted in response to the prior opportunities for comment.

Special Conditions Number	Company and Helicopter Model
No. 29-041-SC <sup>1</sup>	Bell Helicopter Textron Inc. Model 412EP Helicopter
No. 29-022-SC <sup>2</sup>	Eurocopter France Model EC225LP Helicopter
No. 29-027-SC <sup>3</sup>	Agusta S.p.A. Model AW139 and AB139 Helicopter
No. 29-023-SC <sup>4</sup>	Sikorsky Aircraft Corporation Model S-92A Helicopter

### **Comments Invited**

While the FAA did not precede these special conditions with a notice of proposed special conditions, the FAA invites interested people to take part in this rulemaking by sending written comments, data, or views. The most helpful comments reference a specific portion of the special conditions, explain the reason for any recommended change, and include supporting data.

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<sup>1</sup> 82 FR 24458, May 30, 2017

<sup>2</sup> 77 FR 60883, October 5, 2012

<sup>3</sup> 77 FR 44110, July 27, 2012

<sup>4</sup> 75 FR 77524, December 13, 2010

The FAA will consider all comments received by the closing date for comments. The FAA will consider comments filed late if it is possible to do so without incurring expense or delay. The FAA may change these special conditions based on the comments received.

## **Background**

On October 18, 2019, Leonardo applied for a change to Type Certificate (TC) No. R00004RD to install an optional SAR AFCS in the Model AW189 helicopter. The Model AW189 is a transport category helicopter certificated for Category A operations. This helicopter is also certificated for instrument flight under the requirements of Appendix B of 14 CFR part 29, Amendment 29-51. It is powered by two General Electric CT7-2E1 engines and is capable of carrying a maximum of 19 passengers and 2 crew members.

Leonardo proposes that the Model AW189 include the use of a novel and unusual design feature, which is a SAR AFCS. The use of dedicated AFCS upper modes, in which a fully coupled autopilot provides operational SAR profiles, is needed for SAR operations conducted over water in offshore areas clear of obstructions. The SAR modes enable the helicopter pilot to fly fully coupled maneuvers, to include predefined search patterns during cruise flight, and to transition from cruise flight to a stabilized hover and departure (transition from hover to cruise flight). The SAR AFCS also includes an auxiliary crew control that allows another crewmember (such as a hoist operator) to have limited authority to control the helicopter's longitudinal and lateral position during hover operations.

Flight operations conducted over water at night may have an extremely limited visual horizon with little visual reference to the surface even when conducted under Visual Meteorological Conditions. Consequently, the certification requirements for SAR modes must meet Appendix B to 14 CFR part 29. While Appendix B to 14 CFR part 29 prescribes

airworthiness criteria for instrument flight, it does not consider operations below instrument flight minimum speed ( $V_{MINI}$ ), whereas the SAR modes allow for coupled operations at low speed, all-azimuth flight to zero airspeed (hover).

The regulations as currently promulgated did not envision instrument flight below the Appendix B envelope, including hover using AFCS modes. This necessitates the development of a special condition to address the gap in 14 CFR part 29 regulations and the lack of adequate airworthiness standards for AFCS SAR mode certification to include flight characteristics, performance, and installed equipment and systems.

### **Type Certification Basis**

Under 14 CFR 21.101, Leonardo must show the AW189 model helicopter, as changed, continues to meet either the applicable provisions of the regulations incorporated by reference in TC No. R00004RD or the applicable regulations in effect on the date of application for the change, depending on the significance of the change as defined by 14 CFR 21.101. The regulations incorporated by reference in the TC are commonly referred to as the "original type certification basis." The regulations incorporated by reference in R00004RD are as follows:  
14 CFR 21.29 and Part 29, Amendments 29-1 through 29-52 (dated March 30, 2010).  
14 CFR 36, Appendix H, Amendment 36-1 through Amendment 36-29 (dated March 11, 2013).  
Special Condition No. 29-034-SC, 30 Minute All Engines Operating (AEO) Power Rating: 14 CFR 29.1049, 29.1305, 29.1521.

Equivalent Level of Safety Findings (ELOS) issued against:

(a) 14 CFR 29.807(c) Passenger emergency exits (documented in ELOS Memo TC4265RD-R-C-01).

(b) 14 CFR 29.813(c) Passenger access to each emergency exit (documented in ELOS Memo TC4265RD-R-C-02).

(c) 14 CFR 29.807 (d)(2) & (d)(3) Ditching emergency exits for passengers (documented in ELOS Memo TC4265RD-R-C-04).

(d) 14 CFR 29.815 Main aisle width (documented in ELOS Memo TC4265RD-R-C-05).

(e) 14 CFR 29.1545(b) Airspeed indicator (documented in ELOS Memo TC4265RD-R-F-01).

(f) 14 CFR 29.1305 and § 29.1549 Power Index (documented in ELOS Memo TC4265RD-R-F-03).

### **Regulatory Basis for Special Conditions**

The Administrator has determined that the applicable airworthiness regulations (that is, 14 CFR part 29) do not contain adequate or appropriate safety standards for the Leonardo Model AW189 helicopter because of a novel or unusual design feature. Therefore, special conditions are prescribed under the provisions of 14 CFR 21.16.

The FAA issues special conditions, as defined in § 11.19, under § 11.38, and they become part of the type certification basis under § 21.101.

Special conditions are initially applicable to the model for which they are issued. Should the TC for that model be amended later to include any other model that incorporates the same novel or unusual design feature, or should any other model already included on the same TC be modified to incorporate the same novel or unusual design feature, these special conditions would also apply to the other model under § 21.101.

### **Novel or Unusual Design Features**

The Leonardo Model AW189 helicopters will incorporate the following novel or unusual design features:

The SAR system is composed of a navigation computer with SAR modes, an AFCS that provides coupled SAR functions, hoist operator control, a hover speed reference system, and two radio altimeters. The AFCS coupled SAR functions include:

- (a) Hover hold at selected height above the surface.
- (b) Ground speed hold.
- (c) Transition down and hover to a waypoint under guidance from the navigation computer.
- (d) SAR pattern, transition down, and hover near a target over which the helicopter has flown.
- (e) Transition up, climb, and capture a cruise height.
- (f) Capture and track SAR search patterns generated by the navigation computer.
- (g) Monitor the preselected hover height with an automatic increase in collective if the aircraft height drops below the safe minimum height.

These SAR modes are intended to be used over large bodies of water in areas clear of obstructions. Further, the use of the modes that transition down from cruise to hover will include operation at airspeeds below  $V_{MINI}$ .

The SAR system only entails navigation, flight control, and coupled AFCS operation of the helicopter. The system does not include the additional equipment that may be required for over water flight or external loads to meet other operational requirements.

## **Discussion**

The following is a summary of the final special conditions:

(a) In addition to the requirements of 14 CFR part 29 for Category A and Appendix B Helicopter Instrument Flight (IFR), the SAR Helicopter and AFCS must:

(1) Be safe and controllable in flight for all three axes at airspeeds from  $V_{MINI}$  to hover,  
(2) have adequate dynamic stability, and  
(3) provide an automatic transition sequencing from the approved Appendix B IFR envelope without unintended flight below a safe minimum height and return to the Appendix B envelope.

(4) Deliver adequate one engine inoperative (OEI) performance.  
(5) Operate safely in the requested flight envelope, which includes:  
(i) Sea States where the wave height is 2.5m (8.2 feet) and  
(ii) a headwind of 25 knots, 17 knots from all other azimuths.  
(6) Contain relevant limitations and procedures, including operations in salt spray environments.

(b) The design and system architecture of the SAR helicopter must:  
(1) Include a ground mapping radar.  
(2) Incorporate a system to limit engine power demand such that engine limits are not exceeded.

(3) Provide the following to each pilot:  
(i) A selectable Go-Around Mode and minimum safe height,  
(ii) aircraft height above the surface,  
(iii) heading and pilot-selected heading information,  
(iv) aircraft and pilot selected ground speeds when used by the AFCS, and  
(v) wind speed and direction.

(4) Include a system that monitors flight guidance deviations, failures, mode changes and alerts the flight crew.

(5) Provide to the SAR Hoist operator a control which includes a flight control with limited authority, which

(i) is designed, located and safely controllable for that operator without interfering with the safe operation of the helicopter, and

(ii) can be safely overridden by the pilot or copilot.

(6) Ensure the AFCS design is reliable in relation to the effects of its failures and operating environment.

### **Applicability**

These special conditions apply to the Leonardo Model AW189 helicopter. Should Leonardo apply at a later date for an amendment to the TC to include another model incorporating the same novel or unusual design feature, these special conditions would apply to that model as well.

### **Conclusion**

This action affects only certain novel or unusual design features on the Leonardo Model AW189 helicopter. It is not a rule of general applicability.

### **List of Subjects in 14 CFR Part 29**

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

The authority citation for these special conditions is as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701-44702, 44704.

### **The Special Conditions**

Accordingly, pursuant to the authority delegated to me by the Administrator, the following special conditions are issued as part of the type certification basis for the Leonardo Model AW189 helicopter when the optional Search and Rescue (SAR) Automatic Flight Control System (AFCS) is installed:

In addition to the part 29 certification requirements for Category A and helicopter instrument flight for Appendix B, the following additional requirements must be met for certification of the SAR AFCS:

(a) SAR Flight Modes. The coupled SAR flight modes must provide:

(1) Safe and controlled flight in the three axes at all airspeeds (lateral position and speed, longitudinal position and speed, and height and vertical speed) from the previous  $V_{MINI}$  to a hover (within the maximum demonstrated wind envelope).

(2) Automatic transition to the helicopter instrument flight (Appendix B) envelope as part of the normal SAR mode sequencing.

(3) A pilot-selectable Go-Around mode that safely interrupts any other coupled mode and automatically transitions the helicopter to the instrument flight (Appendix B) envelope.

(4) A means to prevent unintended flight below a safe minimum height. Pilot-commanded descent below the safe minimum height is acceptable, provided the alerting requirements in paragraph (b)(8)(i) of these Special Conditions alert the pilot of this descent below safe minimum height.

(b) SAR Mode System Architecture. To support the integrity of the SAR modes, the following system architecture is required:

(1) Ground mapping radar function that presents real-time information to the pilots.

(2) A system for limiting the engine power demanded by the AFCS when any of the automatic piloting modes are engaged, so full authority digital engine control power limitations, such as torque and temperature, are not exceeded.

(3) A system providing the aircraft height above the surface and final pilot-selected height at a location on the instrument panel in a position acceptable to the FAA that will make it plainly visible to and usable by any pilot at their station.

(4) A system providing the aircraft heading and the pilot-selected heading at a location on the instrument panel in a position acceptable to the FAA that will make it plainly visible to and usable by any pilot at their station.

(5) A system providing the aircraft longitudinal and lateral ground speeds and the pilot-selected longitudinal and lateral ground speeds when used by the AFCS in the flight envelope where airspeed indications become unreliable. This information must be presented at a location on the instrument panel in a position acceptable to the FAA that is plainly visible to and usable by any pilot at their station.

(6) A system providing wind speed and wind direction when automatic piloting modes are engaged or transitioning from one mode to another.

(7) A system that monitors for flight guidance deviations and failures and contains an alerting function that provides the flight crew with enough information to take appropriate corrective action.

(8) The alerting system must provide visual or aural alerts, or both, to the flight crew under any of the below conditions:

- (i) When the stored or pilot-selected safe minimum height is reached.
- (ii) When a SAR mode system malfunction occurs.

(iii) When the AFCS changes modes automatically from one SAR mode to another.

For normal transitions from one SAR mode to another, a single visual or aural alert may suffice.

For a SAR mode malfunction or a mode having a time-critical component, the flight crew alerting system must activate early enough to allow the flight crew to take timely and appropriate action. The alerting system means must be designed to alert the flight crew in order to minimize crew errors that could create an additional hazard.

(9) The SAR system hoist operator control is considered a flight control with limited authority and must comply with the following:

(i) The hoist operator control must be designed and located to provide for convenient operation and to prevent confusion and inadvertent operation.

(ii) The helicopter must be safely controllable by the hoist operator control throughout the range of that control.

(iii) The hoist operator control may not interfere with the safe operation of the helicopter.

(iv) Pilot and copilot flight controls must be able to smoothly override the limited control authority of the hoist operator control, without exceptional piloting skill, alertness, or strength, and without the danger of exceeding any other limitation because of the override.

(10) The reliability of the AFCS must be related to the effects of its failure. The occurrence of any failure condition that would prevent continued safe flight and landing must be extremely improbable. For any failure condition of the AFCS which is not shown to be extremely improbable:

(i) The helicopter must be safely controllable and capable of continued safe flight without exceptional piloting skill, alertness, or strength. Additional unrelated probable failures affecting the control system must be evaluated.

(ii) The AFCS must be designed so that it cannot create a hazardous deviation in the flight path or produce hazardous loads on the helicopter during normal operation or in the event of a malfunction or failure, assuming corrective action begins within an appropriate period of time. Where multiple systems are installed, subsequent malfunction conditions must be evaluated in sequence unless their occurrence is shown to be improbable.

(11) A functional hazard assessment and a system safety assessment must address the failure conditions associated with SAR operations.

(i) For SAR catastrophic failure conditions, changes may be required to the following:

(A) System architecture.

(B) Software and complex electronic hardware design assurance levels.

(C) High Intensity Radiated Fields (HIRF) test levels.

(D) Instructions for continued airworthiness.

(ii) The assessments must consider all the systems required for SAR operations to include the AFCS, all associated AFCS sensors (for example, radio altimeter), and primary flight displays. Electrical and electronic systems with SAR catastrophic failure conditions (for example, AFCS) must comply with the § 29.1317(a)(4) HIRF requirements.

(c) SAR Mode Performance Requirements.

(1) Demonstrate the SAR modes for the requested flight envelope, including the following minimum sea-state and wind conditions:

(i) Sea State: Wave height of 2.5 meters (8.2 feet), considering both short and long swells.

(ii) Wind: 25 knots headwind; 17 knots for all other azimuths.

(2) The selected hover height and hover velocity must be captured (to include the transition from one captured mode to another captured mode) accurately and smoothly and not exhibit any significant overshoot or oscillation.

(3) The minimum use height (MUH) for the SAR modes must be no more than the maximum loss of height following any single failure or any combination of failures not shown to be extremely improbable, plus an additional margin of 15 feet above the surface. MUH is the minimum height at which any SAR AFCS mode may be engaged.

(4) The SAR mode system must be usable up to the maximum certified gross weight of the aircraft or to the lower of the following weights:

- (i) Maximum emergency flotation weight.
- (ii) Maximum hover Out-of-Ground Effect (OGE) weight.
- (iii) Maximum demonstrated weight.
- (d) Flight Characteristics.

(1) The basic aircraft must meet all of the part 29 airworthiness criteria for helicopter instrument flight (Appendix B).

(2) For SAR mode coupled flight below  $V_{MINI}$ , at the maximum demonstrated winds, the helicopter must be able to maintain any required flight condition and make a smooth transition from any flight condition to any other flight condition without requiring exceptional piloting skill, alertness, or strength, and without exceeding the limit load factor. This requirement also includes aircraft control through the hoist operator's control.

(3) For coupled flight below the previously established  $V_{MINI}$ , the following stability requirements replace the stability requirements of paragraph IV, V, and VI of Appendix B to part 29:

(i) Static Longitudinal Stability: the requirements of paragraph IV of Appendix B are not applicable.

(ii) Static Lateral-Directional Stability: The requirements of paragraph V of Appendix B are not applicable.

(iii) Dynamic Stability: The requirements of paragraph VI of Appendix B are replaced with the following two paragraphs:

(A) Any oscillation must be damped and any aperiodic response must not double in amplitude in less than 10 seconds. This requirement must also be met with degraded upper mode(s) of the AFCS. An “upper mode” is a mode that utilizes a fully coupled autopilot to provide an operational SAR profile.

(B) After any upset, the AFCS must return the aircraft to the last commanded position within 10 seconds or less.

(4) With any of the upper modes of the AFCS engaged, the pilot must be able to manually recover the aircraft and transition to the normal (Appendix B) IFR flight profile envelope without exceptional skill, alertness, or strength.

(e) One-Engine Inoperative (OEI) Performance Information.

(1) The following performance information must be provided in the Rotorcraft Flight Manual Supplement (RFMS):

(i) OEI performance information and emergency procedures, providing the maximum weight that will provide a minimum clearance of 15 feet above the surface, following failure of the critical engine in a hover. The maximum weight must be presented as a function of the hover height for the temperature and pressure altitude range requested for certification. The effects of wind must be reflected in the hover performance information.

(ii) Hover OGE performance with the critical engine inoperative for OEI continuous and time-limited power ratings for those weights, altitudes, and temperatures for which certification is requested.

NOTE: These OEI performance requirements do not replace performance requirements that may be needed to comply with the airworthiness or operational standards (14 CFR 29.865 or 14 CFR part 133) for external loads or human external cargo.

(f) RFMS.

(1) Limitations necessary for safe operation of the SAR system to include:

(i) Minimum crew requirements. No fewer than two pilots, except for approved external load operations that will also require a hoist operator.

(ii) Maximum SAR weight as determined by the lower of the SAR Mode performance requirement of paragraph (c)(4) of these Special Conditions or the aircraft performance information provided by paragraph (e) of these Special Conditions.

(iii) Maximum demonstrated sea state conditions for ditching compliance.

(iv) Engagement criteria for each of the SAR modes to include MUH (as determined in subparagraph (c)(3)) of these Special Conditions.

(v) Normal and emergency procedures for operation of the SAR system (including operation of the hoist operator control), with AFCS failure modes, AFCS degraded modes, and engine failures.

(2) Performance information:

(i) OEI performance and height-loss.

(ii) Hover OGE performance information, utilizing OEI continuous and time-limited power ratings.

(iii) The maximum wind envelope demonstrated in flight test.

(iv) Information and advisory information concerning operations in a heavy salt spray environment, including any airframe or power effects as a result of salt encrustation.

(g) Flight Demonstration.

(1) Before approval of the SAR system, an acceptable flight demonstration of all the coupled SAR modes is required.

(2) The AFCS must provide fail-safe operations during coupled maneuvers. The demonstration of fail-safe operations must include a pilot workload assessment associated with manually flying the aircraft to an altitude greater than 200 feet above the surface and an airspeed of at least the best rate of climb airspeed ( $V_y$ ).

(3) For any failure condition of the SAR system not shown to be extremely improbable, the pilot must be able to make a smooth transition from one flight mode to another without exceptional piloting skill, alertness, or strength.

(4) Failure conditions that are not shown to be extremely improbable must be demonstrated by analysis, ground testing, or flight testing. For failures demonstrated in flight, the following normal pilot recovery times are acceptable:

(i) Transition modes (Cruise-to-Hover/Hover-to-Cruise) and Hover modes: Normal pilot recognition plus 1 second.

(ii) Cruise modes: Normal pilot recognition plus 3 seconds.

(5) All AFCS malfunctions must include evaluation at the low-speed and high-power flight conditions typical of SAR operations. Additionally, AFCS hard-over, slow-over, and oscillatory malfunctions, particularly in yaw, require evaluation. AFCS malfunction testing must

include a single or a combination of failures (such as, erroneous data from and loss of the radio altimeter, attitude, heading, and altitude sensors) that are not shown to be extremely improbable.

(6) The flight demonstration must include the following environmental conditions:

(i) Swell into the wind.

(ii) Swell and wind from different directions.

(iii) Cross swell.

(iv) Swell of different lengths (short and long swell).

(7) The flight demonstration must also evaluate OEI procedures from hover while hoisting an external load.

Issued in Fort Worth, Texas, on July 31, 2020.

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Policy & Innovation Division

Aircraft Certification Service

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