SUBJECT: Approval of flight in snow condition - Pilot visibility

CATEGORY: Special Condition

REQUIREMENT(S): CS 27 since initial issue

ADVISORY MATERIAL: See annex II

PRIMARY PANEL: --

SECONDARY PANELS: --

CRI CLOSURE TARGET: --

NEXT ACTION BY: --

INTRODUCTION

The hereby presented Special Condition has been classified as important SC and as such shall be subject to public consultation, in accordance with EASA Management Board decision EASA MB 02/04, MB Decision n° 7-2004 products certification procedure, 30 March 2004, Article 3 (2.) of which states: *"2. Deviations from the applicable airworthiness codes, environmental protection certification specifications and/or acceptable means of compliance with Part 21, as well as important special conditions and equivalent safety findings, shall be submitted to the panel of experts and be subject to a public consultation of at least 3 weeks, except if they have been previously agreed and published in the Official Publication of the Agency. The final decision shall be published in the Official Publication of the Agency."*

STATEMENT OF ISSUE

According to CS 27, the only issue to be addressed for flight in snow condition is the proper operation of a turbine engine following the requirement of sub-paragraph (b) of § 27.1093 - Induction system icing protection. No equivalent requirement exists for helicopters powered by piston engines.

The corresponding paragraph of AC 27-1B defines a test spectrum which requires the applicant to perform hover flights and a 1 hour long level flight, with snow conditions leading to a 400 m horizontal visibility with critical negative temperatures.

During these flight tests for existing helicopters powered by turbine engine, snow accretion was sometimes observed on the helicopter windshield, leading to a dangerous reduction in pilot view. Only use of wipers - associated with sufficient heating/demisting performance - could restore acceptable visibility.

Current CS 27 and AC 27-1B contain no specific requirement and guidance for visibility in snow condition to protect against potential accumulation on canopy/windshield. But so far this issue of pilot view obstruction in snow falls has been addressed by the European light helicopter manufacturers and the European airworthiness authorities as a side issue during flight test demonstration for a turbine engine installation.

Consequently EASA considers that issuance of a special condition is necessary to define a requirement for pilot view of the flight path during flight in snow falls compatible with VFR conditions, whatever the type of engine powering a light helicopter. EASA considers also that flight testing is defined as an acceptable mean of compliance with that special condition.

Considering that:

- current European operational regulations often define a quite low minimum horizontal visibility for Special VFR operations with helicopter (e.g. 800 m in France, and in some countries, no limit distance but a simple "outside of clouds" provision),
- a helicopter can perform hover flights in re-circulating snow, take-off under snow falls and fly with falling snow compatible with the Special VFR limit visibility, and
- the general spirit of the airworthiness requirement and associated guidance is to cover with margins any phenomenon of which the severity is difficult to assess,

EASA retains test conditions similar to those of AC27-1B Change 3, paragraph AC 27.1093(c) as being appropriate for flight testing intended to demonstrate compliance with the proposed special condition.

SPECIAL CONDITION

See annex I of this CRI.

DISCUSSION

EASA position (Issue 1, dated 04 May 2011):

Piston-operated helicopter under certification shall comply with this special condition. Flight testing in the conditions given in annex II of this CRI is an acceptable means of compliance with this special condition.

Applicant's position (Issue 2, dated xx/xx/ 2011):

CONCLUSION:

Signed PCM PCM	Date: / /2011

Annex I

Special condition for flight in snow condition with a small rotorcraft

If certification for flight in snow condition is requested, it must be demonstrated that snow, both falling and blowing, does not accumulate on the rotorcraft windshield and windows so that pilot view of the flight path is not unduly impaired during taxiing, hover flight, take-off, level flight and landing.

Annex II

Flight in snow condition with a small rotorcraft – Acceptable means of compliance

(1) Guidance.

(i) It is EASA opinion that small rotorcraft operation in falling and blowing snow can be approved without restriction if normal operations with no hazardous reduction in pilot's view of the flight path,are demonstrated under the following conditions:

Visibility:	¼ mile or less as limited by snow.
Temperature:	25° F to 34° F (28° F to 34° F desired), unless other temperatures are deemed critical.
Operations:	Ground operations - 20 minutes
	IGE hover - 5 minutes
	Level flight - 1 hour
	Descent and landing

(ii) Rotorcraft Flight Manual visibility restrictions for falling and blowing snow operations are not appropriate.

(iii) Time limitations, other than possibly for ground and hover operations, are not appropriate.

(iv) Artificially produced snow should not be used as the sole means of showing compliance.

(2) Guidance Rationale.

(i) The test conditions specified -- visibility, temperature, and operations -- are similar to those used for certification of turbine engine powered rotorcraft for operation in snow conditions according to § 27.1093(b)(1)(ii).

(A) Visibility. The test visibility defined, ¼-mile visibility or less as limited by snow, represents a heavy snowstorm and is the maximum likely to be encountered in service. It is important to note that the visibility specified is a test parameter rather than an operational limitation to be imposed on the rotorcraft after the tests are completed.

(B) Temperature.

(1) The ambient temperature specified is conducive to wet snow conditions. Wet snow tends to accumulate on unheated surfaces subject to impingement.

(2) Company development testing or experience with similar rotorcraft may be adequate to determine the critical ambient conditions for certification testing.

(C) Operations.

(1) Ground running, taxiing, and IGE hover operations are generally the most critical since the rotorcraft may be operating in recirculating snow. Twenty-five minutes under these extreme

conditions would seem a reasonable maximum, both from the view of pilot stress and the maximum expected taxi time prior to takeoff in bad weather.

(2) One hour of level flight operation under ¼-mile visibility snow conditions should provide ample opportunity for hazardous accumulations to begin to build.

(ii) Visibility may fluctuate rapidly in snowstorms. It is affected by the presence of fog or ice crystals, is not crew measured or controlled, and is difficult to estimate. A visibility operational limitation based on snow, therefore, is not appropriate.

(iii) Since during cruise in snow conditions the aircraft is likely to be in and out of heavy snowfall, it is not practical for the crew to account for the time spent in snow in level flight conditions. Thus, it is not appropriate to include time limitations in the RFM for level flight snow operations.

(iv) A practical ground and IGE hover time limitation of less than 25 minutes in recirculating snow may be considered. The expected action at the expiration of this specified time period would be landing or transition to a safe flight condition where demonstration has shown that snow accumulations will not intensify or shed and so not cause unacceptable reduction in pilot visibility.

(v) Artificially produced snow is an excellent development tool. Artificial snow production devices are usually restricted to use for hover and ground evaluations, and the snow pellets produced by these machines are not sufficiently similar to natural snowflakes to justify the use of artificial snow as the sole basis of certification.

(3) Procedures.

(i) Satisfactory demonstration of the test conditions requires that the windshield and windows remain free of excessive snow accumulation. Excessive accumulation is defined as accumulation that may cause hazardous reduction in pilot's view of the flight path..

(ii) The conditions specified assume actual flight demonstration in natural snow. The ground operations and IGE hover test conditions assume operation in recirculating snow. Blowing snow, resulting from rotor airflow recirculation, can be expected to be more severe than natural blowing snow if the rotorcraft continues to move slowly over freshly fallen snow. Thus, the blowing snow operational capability is usually demonstrated by the taxi and hover operations in recirculating snow.

(iii) For VFR rotorcraft, the airspeeds for the level flight test condition should include the maximum consistent with the visibility conditions. For IFR operations, the airspeed should be the maximum cruise speed or the maximum speed specified for snow operations in the flight manual limitations, unless other airspeeds are deemed more critical. It is recognized that many rotorcraft initially certified VFR are later IFR certified with a resulting possible increase in airspeed in snow conditions. This factor should be considered if IFR certification is anticipated.

(iv) The visibility specified assumes that visual measurements are made in falling snow in the absence of fog or recirculating snow by an observer at the test site outside the tests rotorcraft's area of influence. An accepted equation for relating this measured visibility to snow concentration is $V = 374.9/C^{0.7734}$ where C is the snow concentration (grams/meter^3) and V is the visibility (meters).

(A) This equation can be reasonably applied to all snowflake type classifications and is credited to J.R. Stallabrass, National Research Council of Canada.

(B) Other equations may be applied if they are shown to be accurate for the particular snowflake types for the test program.

(v) The snow concentration corresponding to the visibility prescribed, ¼ mile or less, will be extremely difficult to locate in nature. Data from Ottawa, Canada, research indicate that fewer than 4 percent of the snowstorms encountered there meet the 0.91 grams/m^3 concentration associated with the ¼-mile visibility. Furthermore, the likelihood that the desired concentration will exist for the duration of the testing is even more remote. Because of these testing realities, it is very likely that exact target test conditions will not be achieved. Those involved in certification must exercise good judgment in accepting alternate approaches.

(vi) If it becomes apparent that snow accumulations in ground and IGE hover operations in recirculating snow are much more severe than in the level flight test, it is reasonable to accept prolonged IGE operations in recirculating snow and to accept durations of less than 1-hour level flight in ¼-mile or less visibility. Best efforts should be made to assure that at least some level flight time is accomplished at ¼-mile or less visibility to assure that the spectrum is covered.

(vii) It should be determined that the visibility established at the test sight is limited by snow and not by fog or poor lighting (twilight) conditions.

(viii) Recirculation is necessarily a qualitative judgment by the test pilot. For test purposes, recirculation should be the highest snow concentration attainable in the manoeuvre, or that corresponding to the lowest visibility at which (in the pilot's judgment) control of the rotorcraft is possible in the IGE condition. The visibility specification of ¼ mile or less outside of the recirculation influence becomes inconsequential provided that fresh, loose snow is continually experienced during the ground operation and IGE hover testing phase. However, since it is intended that the test phases be accomplished sequentially to assure that transition to takeoff and other transients are considered, the conditions at takeoff, level flight, and descent and landing should approximate the ¼-mile visibility criteria.