

EASA Special Condition

CS 27 Special Condition

30-Second One Engine Inoperative Power Limits – Limit Override Feature

Bell Helicopter Textron Canada Limited Model 429

1. General

This Special Condition contains airworthiness requirements for the type certification of the Bell Model 429 helicopter. This dual-engine helicopter has a novel or unusual design feature associated with the automatic engine power limiters, in that there is a provision for the crew to selectively override the limits associated with rated 30-second OEI power. The applicable airworthiness code does not contain adequate or appropriate safety standards for a helicopter incorporating such a feature.

This Special Condition contains the additional airworthiness standards as being necessary to ensure that the type design will provide a level of safety equivalent to the level that would result from compliance with the applicable Certification Specifications after the loss of one engine. (See additional information in Background and Discussion).

2. Background and Discussion

The basis of certification for the Bell Helicopter Textron Canada (BHTCL) Model 429 helicopter includes Certification Specification CS27 – *Normal Category Rotorcraft*, Initial Release that adopts 30-second/2-minute OEI Power.

The rated 30-second OEI power is limited to periods of not over 30 seconds at any one time and may be used to enhance the OEI performance of the rotorcraft during the transient phase of the take-off and landing manoeuvres. The rated 2- minute OEI power is limited to periods of not over 2 minutes at any one time and may be used to achieve initial stabilized climb of at least 100 feet per minute following takeoff or balked landing flight with one engine inoperative.

Following an in-flight failure or a precautionary shutdown of an engine, rotorcraft certificated for a 30-second OEI power rating must provide a means to automatically activate and control the engine power and prevent any engine from exceeding the installed engine limits associated with the 30-second OEI power rating approved for the rotorcraft. Additionally, a device is required to alert the crew to the start and expiration (or impending expiration) of the 30-second interval. The engine requirements of CS33 allow that use of the 30- second/2-minute OEI power level may damage the engine; therefore, mandatory maintenance and inspection limitations are required to identify appropriate action prior to subsequent dispatch of the rotorcraft. The degree and extent of the use of these power ratings is required to be recorded on a device that can be reset only by ground maintenance personnel.

The Model 429 will comply with these CS33 requirements. However, it is recognized that, specific to the Model 429, the automatic devices that activate and control the 30-second OEI power also continue to protect power sensitive components of the transmission and rotor drive system from excessive loads, stresses or other damaging conditions. Following use of 30-second OEI power, subject to confirmation by mandatory maintenance inspection, engines and other rotorcraft components are typically expected to be fit for return to service without any overhaul or repair. As such, the Model 429 30-

second OEI power rating does not closely approach the ultimate power capabilities (i.e. there is a safety margin) of the engines nor inflict damage upon the engines during each use, as expected by the power levels envisaged by the applicable standards for certification with a 30-second/2-minute power rating.

It is expected that the 30-second OEI power rating will only be used during the highly critical, low-altitude phases of flight for take-off or landing. In the case of an exceptional emergency when close to the ground, such as an upset or wind gust causing imminent collision with terrain, BHTC has requested the incorporation into the Model 429 of a limit override switch, allowing the pilot to exercise judgement to access all available (near-ultimate) engine power as a last resort to recover the aircraft or to reduce the severity of impact with terrain.

The use of the limit override feature is expected to closely approach the ultimate power capabilities of the engines and may inflict some damage upon the engine during each use. The potentially damaging aspects of this feature are offset by the increased safety provided to the rotorcraft and its occupants by preventing or lessening the effect of collision with terrain or other obstacles.

For certification with a 2 ½ -minute OEI power rating, there is no requirement to automatically activate and control the engine power to the rated power level. Hence, the crew is not prevented from exceeding rated limits, as required for operational safety. With respect to the limit override feature, when activated, the engine would be limited to integrity limits rather than the open-ended engine operation to destruction capability that would be allowed by certification to the 2 ½ -minute OEI power rating standard. In addition, this Special Condition requires that a device or system be provided to record the exceedance of any 30- second OEI limit.

EASA considers that safety after an engine failure under this proposed Special Condition will be at least equivalent to operational safety provided by compliance to the applicable standards for a 2 ½ -minute OEI rated helicopter.

3. Definitions

For the purpose of this Special Condition,

"Integrity limit" means the point at which a representative test article was successfully operated without imminent structural failure or operational anomaly;

4. Airworthiness Requirements

To provide a capability to override rated 30-second OEI limits, the Model 429 helicopter shall comply with the following:

(a) General:

During OEI operation, where the operating engine is automatically limited to the rated 30 second OEI power, a means is provided for the pilot to selectively override the automatic limiter in order to allow the remaining operational engine to operate within its integrity limit. The capability to override the automatic limiter is intended for a one-time use, as a last resort safety feature to allow pilots to recover from extreme emergency to prevent or reduce the effect of collision with terrain or other obstacles. Continued availability of certified engine and helicopter performance would not be assured following exceedance of the 30-second power limit with the override feature selected. Continuation of extended flight after using the limit override feature to exceed rated 30-second OEI limits will not be

permitted. No power rating, duration of power availability, or assurance of continued reliability and performance are implied by this Special Condition.

(b) *Availability and selection:*

- (1) The cockpit control used to select the limit over-ride feature shall be guarded against inadvertent crew selection;
- (2) The limit override function can only be activated when the control has been selected during an OEI event (in case of selection with all engines operating or outside OEI power range, it shall be necessary to de-select and re-select the cockpit control to arm the limit override feature); and
- (3) The means to select the default limits associated with rated 30- second OEI limits shall always be available to the crew.

(c) *Crew indication:*

In addition to the requirement of CS27.1305(t), the crew shall-

- (1) be alerted when the limit override feature is selected;
- (2) be advised by unambiguous engine displays when the rated 30- second OEI limits are being exceeded; and
- (3) be provided cockpit indication that any 30-second OEI limit has been exceeded, and this indication can only be reset by ground maintenance personnel.

(d) *Design criteria and protection from failure:*

It shall be shown by design and tests that-

- (1) no additional hazard is introduced by the incorporation or use of the limit override feature;
- (2) any failure in the means to select the limit override feature, or in the inoperative engine EEC, shall not prevent the limiter in the operative engine to automatically control to rated 30-second OEI limits;
- (3) use of the limit override feature does not allow exceedance of any ultimate limit of the engine, transmission, drivetrain, or airframe; and
- (4) rated 30-second OEI limits are automatically made available during and after any limit override feature failure, malfunction, or probable combination thereof.

(e) *Limitations:*

In addition to the CS27.1521 powerplant limitations-

- (1) Following use of the 30-second OEI limit override feature to exceed the rated 30-second OEI limits, the aircraft shall:
 - (i) land as soon as possible; and
 - (ii) not be operated until appropriate maintenance actions have been performed.
- (2) The following warning, or a similarly agreed upon wording, shall be included in the Limitations Section of the Rotorcraft Flight Manual:

WARNING

*EXCEEDANCE OF 30-SECOND OEI POWER WITH THE LIMIT
OVERRIDE FEATURE IS LIMITED TO A ONE-TIME USE OF
MINIMIZED DURATION. LAND AS SOON AS POSSIBLE. AFTER
LANDING, THE AIRCRAFT IS UNSERVICEABLE. AIRCRAFT
MAINTENANCE WILL BE REQUIRED.*

(f) *Certification Tests:*

In addition to the CS27.923(e)(2) rotor drive system and control mechanism test requirements-

- (1) It shall be demonstrated by engine test that operation to integrity limits does not cause engine abnormalities or imminent structural failure.
- (2) It shall be demonstrated by flight test and analysis that the helicopter and engine under test are free of hazards and anomalies during selection and operation of the 30-second OEI limit override feature.

(g) *Maintenance:*

In addition to the CS27.1305(u) requirements, for each turbine engine featuring a limit override, a device or system must be provided which:

- (1) Automatically records each usage and duration of exceedance of 30-second OEI power with the limit override feature activated;
- (2) Permits retrieval of the recorded data;
- (3) Can be reset only by ground maintenance personnel; and
- (4) Has a means to verify proper operation of the system or device.

(h) *Manuals:*

The Rotorcraft Flight Manual, Maintenance Manual, and Engine Installation and Maintenance Manuals shall provide clear descriptions, instructions, required actions following its use, and warnings for the limit over-ride feature.