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PART 6—ROTORCRAFT AIRWORTHINESS; NORMAL CATEGORY

Turbine Powered Rotorcraft

This amendment to Part 6 adds airworthiness requirements specifically related to turbine powered rotorcraft. Minor changes are made in rules applicable to reciprocating powered rotorcraft as well. The contents of this amendment were published by the Federal Aviation Agency as a notice of proposed rule making (27 F.R. 12224) and circulated as Civil Air Regulations Draft Release No. 62-52 dated December 11, 1962.

Among the general comments received in response to the draft release was an expression of concern that the proposed requirements would, if adopted as rules, have retroactive applicability. No statement of retroactive application was contained in the draft release, nor intended, nor are the rules adopted herein retroactive.

The following is a discussion of the major issues raised in comments received in response to Draft Release No. 62-52, and changes made in the rules proposed therein:

1. Sections 6.111 and 6.116 *Takeoff; limiting height and speeds for safe landing following power failure.* Present § 6.116 requires determination of the limiting range of heights and speeds within which it is not possible to make a safe landing following power failure. From this and other related requirements, a height-velocity envelope is established to inform the pilot of critical heights and speeds to be avoided during takeoff and in sustained powered flight.

In determining the range of heights and speeds for safe landings following power failure, it has been the general practice in the past to conduct tests only at one field elevation. The height-velocity envelope derived therefrom was established for sea level conditions and assumed to be applicable over the range of operating altitudes. Because the range of operating altitudes of the early helicopters was limited by performance, the height-velocity envelope was not determined by taking into account the effects of altitude.

Since 1956, tests have been conducted at relatively high field elevations to determine the effect of altitude on the height-velocity envelope and to permit comparison of performance at high and low field elevations. Several of these tests resulted in accidents. The characteristics of the height-velocity envelope were found to be sufficiently different at altitude that considerable weight reduction was necessary to obtain an envelope similar to that for sea level conditions. The current rules do not preclude altitude accountability in the determination of the limiting heights and speeds for safe landing. However, in view of the foregoing § 6.116 is amended by including a provision that expressly requires the height-velocity envelope to be determined at maximum certificated weight and at other weights and corresponding altitudes selected by the applicant up to 7,000 feet.

The related provisions of present § 6.111 require demonstration of a takeoff procedure at maximum certificated weight that will enable a landing to be made at any point along the takeoff flight path in the event of an engine failure. It follows, therefore, that the takeoff flight path must be outside the height-velocity envelope established under § 6.116. Since present § 6.111 requires a demonstration of takeoff procedures at only the maximum certificated weight, it too is amended to provide for altitude accountability by requiring a showing that a safe landing can be made following a power failure during takeoff at maximum certificated weight and at other weights and corresponding altitudes selected by the applicant up to 7,000 feet.

The upper limit of the altitude range over which §§ 6.111 and 6.116 must be complied with was not specified in the draft release but was added to the final rule after one comment on the proposal expressed concern that compliance with it would require takeoff and landings to be made from inaccessible sites and at field elevations neither practical or readily available for test purposes. The proposed takeoff provisions of § 6.111 were not intended to apply beyond a range of altitudes that would encompass most takeoffs and landings. However, the Agency recognizes that the draft release did not clearly define such a range and the final rule has therefore been revised to accomplish this. The range between sea level and 7,000 feet is deemed a reasonable altitude range for determining the takeoff and height-velocity perform-

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ance of rotorcraft certificated under Part 6. In addition, domestic airports at field elevations above 7,000 feet are few in number and most operations will be conducted within this altitude range. If performance data above 7,000 is deemed necessary, it may be obtained as provided for in § 6.100.

One comment on proposed § 6.111(c) suggested that the word "shown" as used there could be interpreted to require an actual demonstration. This is not necessarily so if compliance can be determined by other acceptable means as provided in § 6.100(a). However to avoid any confusion on this point, the word "determined" has been inserted in lieu of "shown". Also, the requirement that takeoff be demonstrated at maximum certificated weight in proposed § 6.111(a) has been deleted from the final rule since that requirement is also set forth in new § 6.111(c).

A comment was made proposing a change to proposed § 6.116 to permit the applicant to select a single altitude at which the height-velocity envelope would be established other than for sea level conditions and at maximum certificated weight. This is not acceptable because there is no assurance that the height-velocity envelope would be established over the range of altitudes within which most operations are likely to occur.

2. Section 6.113 *Minimum operating speed performance.* Present § 6.113(b) prescribes a minimum hovering ceiling, for helicopters, of not less than 4,000 feet under standard atmospheric conditions and at maximum weight. The turbine engine is considerably more sensitive to the effects of ambient temperature in developing power than is the reciprocating engine. As a result, ambient temperatures higher than the standard atmospheric conditions will impair the hovering performance of turbine-powered helicopters to a greater degree than in the case of helicopters equipped with reciprocating engines. Therefore, compliance with the minimum hovering ceiling requirements of § 6.113(b) does not necessarily insure that turbine-powered helicopters will have an overall level of hovering performance equivalent to reciprocating-engine-powered helicopters under the same temperature conditions.

From an analysis of hovering performance data of helicopters equipped with sea level reciprocating engines, it appears that reasonable equivalence in overall hovering capabilities can be obtained if turbine-powered helicopters possess hovering capability at a pressure altitude of 2,500 feet and a temperature of standard plus 40° F. Because of the foregoing, § 6.113 is being amended by making the currently effective paragraph (b) applicable to reciprocating-engine-powered helicopters, and by introducing a new paragraph incorporating the aforementioned hovering ceiling criteria for turbine-powered helicopters.

3. Section 6.121 *Controllability.* The present rules do not include provisions for rapid power recovery when the power control is advanced from the idle position. For helicopters, rapid transition to powered flight is necessary for recovery following autorotative approaches, where the use of improper flare techniques close to the ground might result in an accident. Rapid power response affords protection during autorotation training and practice, and in other landing operations.

Reciprocating engines can be made to respond rapidly to throttle opening. In the case of at least one turbine-powered helicopter, however, the engine manifested delayed power recovery characteristics following autorotative approaches and rejected landings. It was proposed, therefore, to amend § 6.121(a) by adding a new sentence at the end thereof which would require demonstration of a prompt recovery following an autorotative approach.

Two comments were made on the proposal, both of which pointed out that the word "promptly", which was used to qualify the recovery from the autorotative approach to power-on flight, would be subject to different interpretations. One comment went on to say that the word "promptly" was not considered to have the same meaning for both reciprocating and turbine-engine installations and, for this reason, the applicant should be required to demonstrate only that the engine installation does not detract significantly from the ability of the engine to respond. A suggestion was made to revise the proposal by using "safely" in lieu of "promptly". Accordingly, a change is being made to § 6.121 (a) by adding a new provision to require that the helicopter be able to recover safely from a balked autorotative approach to power-on flight.

4. Section 6.251 *Fuselage, landing gear, and rotor pylon structure.* The draft release proposed to amend § 6.251 (c) by requiring that a factor of 1.25 be applied to the mean engine torque to account for turbine-engine power surges under accelerated flight and landing conditions. One comment recommended that this requirement be qualified to permit the application of a factor less than 1.25 if this reduced factor is supported by tests. The Agency believes that the 1.25 factor (which has already been prescribed for turbine-powered aircraft in other parts of the airworthiness regulations) is a reasonable standard for all turbine-powered rotorcraft type certificated under the provisions of Part 6. Accordingly, § 6.251(c) is being amended as proposed.

5. Section 6.304 *Protection.* Present § 6.304(a) requires that the rotorcraft structure be protected against deterioration or loss of strength due to weathering, corrosion, abrasion, or other causes. It was proposed in the draft release to add a requirement that all parts of the rotorcraft be protected against deterioration due to engine exhaust gases as well. One comment pointed out that the phrase "or other causes" in the present regulation embraces engine exhaust gases, and that mention of this cause improperly implies that turbine installations require more protection from deterioration due to exhaust than do reciprocating installations. Another comment point out that the proposed deletion of the phrase "where necessary for protection" from present § 6.304(b) (which requires ventilation and drainage provisions), unjustifiably imposes a requirement for ventilating and draining all parts of the rotorcraft regardless of need. The Agency agrees with both of these comments and the final rule has been revised accordingly. Present § 6.304 (c) is superfluous and has been deleted, and the provisions of present §§ 6.304(a) and 6.304(b) have been combined in one section.

6. Section 6.401 *Engines.* Section 6.401 of Subpart E (relating to powerplant installation) is amended by the addition of a requirement that neither engine combustion flameout, nor compressor stall or surge shall prevent compliance with the demonstration of flight characteristics required by § 6.120. That section requires compliance with certain provisions pertaining to controllability, trim, and stability at all normally expected operating altitudes, under all critical loading conditions, and for all speeds, power, and rotor speed conditions for which certification is sought. Present § 6.120(b) requires that it shall be possible to maintain a flight condition and to make a smooth transition from one flight condition to another without requiring an exceptional degree of skill, alertness, or strength on the part of the pilot. These requirements do not take into account any effect that turbine engine characteristics might have on the execution of rotorcraft control and maneuver. Section 6.401 is therefore amended as set forth above. The proposed text of § 6.401(c) stated in part that "* * * engine combustion flameout shall not occur nor shall compressor stall or surge affect any of the prescribed maneuvers." A comment was made that the proposal did not define the degree of "affect" that would be permissible and in no way determines the effect of maneuvers on engine operation. The proposed requirement was intended to disclose whether the effect of stall or surge prevented compliance with the maneuver requirements, regardless of whether the maneuvers or something else caused the onset of stall or surge. The final rule has been clarified in this respect.

7. Section 6.427 *Strainers.* Present § 6.427 requires a strainer to be incorporated in the fuel system between the tank and the engine. Turbine engine fuel can contain significant quantities of dissolved and entrained water which might, under low temperature conditions, precipitate from the fuel onto the strainer. Section 6.427 is, therefore, amended by adding a provision, for turbine engines, to require automatic maintenance of fuel flow when ice-clogging of the strainer occurs, unless means are incorporated in the fuel system to prevent the accumulation of ice particles on the strainer. This requirement is the same as the requirement which has been applied to turbine transport airplanes type certificated in accordance with Part 4b of the Civil Air Regulations, and is added because rotor-

craft type certificated in accordance with Part 6 can be exposed to a similar environment. Rotorcraft operated in northern latitudes can be exposed to low temperature atmosphere and the fuel temperature reduced below the freezing temperature of water. This is a situation conducive to formation of ice particles in the fuel system.

Two comments were made on the proposal to amend § 6.427. The first was that further definition of fuel and icing is required because the same requirements should not be required for fuels such as aviation gasoline which can be used and which are not susceptible to icing. Turbine engines usually are certificated to use turbine fuels, which are susceptible to icing, with a secondary specification for the use of aviation gasoline as a fuel. In the improbable event that aviation gasoline is specified as the only fuel to be used in a particular turbine engine, and appropriate limitations to that effect are established, it is possible that the rotorcraft might still be found eligible under § 6.10 for issuance of a type certificate, even when not in compliance with the requirement. The second comment expressed concern that although the language of the proposal seems clear that, as a means of compliance, a suitable bypass in case of filter clogging is acceptable, there was reason to believe that the rule might not be so construed in all cases. The proposal was constructed deliberately to neither require nor prohibit a bypass as a means of compliance, or for any other reason. The use of an automatic filter bypass is an acceptable way of maintaining fuel flow if the filter ice-clogs. The final rule has therefore not been changed in any respect.

8. Sections 6.450–6.452 *Cooling tests.* Present §§ 6.450 and 6.451 deal with powerplant cooling capability and require tests to show that powerplant temperature limits can be maintained. It was proposed to arrange these requirements in the same form adopted for other parts and to clarify their general applicability to turbine engine installations as well as reciprocating engine installations. It was also proposed to specify in a new § 6.452, test conditions based on applicable rotorcraft performance requirements. Present rules require cooling capability to be shown under an anticipated hot day temperature of 100° F., but do not limit rotorcraft operation to ambient atmospheric temperatures at or below that temperature. The proposal in the draft release would have permitted the applicant to select the maximum ambient atmospheric temperature at which cooling capability is to be shown and would have established the selected temperature as an operating limitation.

Two comments were made on the proposals to amend the cooling requirements. The first comment was an objection to the proposed requirement establishing an ambient atmospheric temperature limitation on the operation of a rotorcraft. It was contended that no need had been shown for imposing such a limitation and that engine operational temperature limits have been adequate in providing for safe operation. The intent of this aspect of the proposal was not to supplant existing limits on cylinder, oil, and other temperatures, but to give the applicant greater freedom in determining the capability of the cooling system and to set forth the temperature limit to which that capability had been demonstrated and beyond which operation should not be permitted. The Agency agrees, nevertheless, that cooling capability is adequately determined under existing regulations whether or not such a limitation is established and, therefore, the presently effective rules are being retained with respect to the arbitrary hot-day condition, with no requirement being adopted for an ambient atmospheric temperature limitation. Accordingly, proposed §§ 6.1(c)(2), 6.603(d), and 6.714(d), all of which dealt with the proposed ambient atmospheric temperature limitation, are not included in the amendments adopted herein.

The second comment was a request to retain the existing cooling test procedures because: There is no reason to change them, the existing requirements are to investigate hover, climb, and maximum speed conditions, and takeoffs and landings are conditions which are too transient to require testing. The Agency disagrees and the cooling test procedures are adopted in a new § 6.452 as proposed. These procedures, in fact, provide substantial relief from the presently effective rule which requires that the cooling system be capable of maintaining engine temperatures within safe operating limits under all conditions of flight during a period at least equal to that established by the fuel capacity of the rotorcraft. Rather than prolonging an operation far beyond its normal extent, which is not practical, the final rule requires a test of cooling capability only through the course of a normal operation. The only change from existing procedures is in the requirement to precede the takeoff-cooling test by a stabilization period at hover, a procedure carried out in serivce. Takeoff in these circumstances would not be a transient condition. Present cooling test procedures clearly require a demonstration of cooling capability during all conditions, including takeoff and landing, and the new procedures are substantively unchanged in this respect.

9. Sections 6.460–6.463 *Induction and exhaust systems.* Presently effective §§ 6.460 through 6.463 deal with the induction and exhaust systems. Although these sections have general applicability, regardless of the type of engine used, the provisions in detail cover reciprocating engines only. Because of the differences in configuration, operation, and characteristics between turbine and reciprocating engines, it is necessary to add similar details covering turbine engines. Accordingly, § 6.460 is being amended to incorporate the general requirement for induction systems which is presently contained in § 6.461(a). Section 6.461 is being amended to make the provision of paragraph (c), covering drains, generally applicable.

Foreign object ingestion can damage turbine compressors. Service experience with military type aircraft operating from undeveloped or unclean ramp and runway areas shows that compressor damage due to foreign objects is one of the major causes of premature engine change and compressor failures. Helicopters, while operating on the ground or hovering in ground effect, produce a strong recirculation pattern of airflow through the rotor disk which is capable of lifting objects from the ground and whirling them about the helicopter. Turbine engines used in helicopters type certificated in accordance with Part 6 are lightly constructed and, therefore, are especially vulnerable to compressor damage. Section 6.461 is being amended, therefore, by adding a provision (§ 6.461(c)), for turbine engines, to require that operation of turbine engines from idle to the start of takeoff shall not result in pebble ingestion into the induction air inlet during rotorcraft operation on a defined bed of pebbles. The objective of this amendment is to protect the engine against foreign object damage and thereby avoid engine failure from this cause.

Section 6.462 is also being amended by adding a provision (§ 6.462(b)) for the protection of turbine engines in icing conditions by requiring that the engine installation shall not adversely affect the capability of the engine to operate in accordance with the provisions of § 13.210-(c) of Part 13 of the Civil Air Regulations. This addition more specifically covers the effect of installation on the ice protection features of the engine than the general terms of § 6.462(a).

Section 6.463 has been revised to clarify the extent of its applicability to turbine engine rotorcraft. Accordingly, the phrase "carburetor air intake" in present § 6.463(b)(1) has been changed to "engine air intake" in § 6.463(c) of the amended rule. A provision is added requiring drains for turbine engine exhaust systems to prevent the accumulation of fuel after the failure of an attempted engine start. Also, because of the difficulty of insuring that turbine engine exhaust gases are discharged clear of rotorcraft structure, and the possible ambiguity of this requirement with respect to the provisions of § 6.304, this provision of present § 6.463(b)(1) is being deleted. In this connection, the similar provision of that section requiring that exhaust gases shall be discharged clear of cowling, is contradictory to § 6.484(d) which permits impingement of exhaust gases on cowling under certain conditions. The word "cowling" is therefore, being deleted from the final rule.

Several comments were made on the induction system and exhaust system proposals. The first, made with respect to proposed § 6.461(b), was a request to insert the phrase, "when fuel accumulation is possible," for the reason that not all turbine induction systems can accu-

mulate fuel and drains should not be required for an installation where fuel will not accumulate. The Agency concurs and the requirement is being revised accordingly. A request also was made to reword paragraph (c) to permit compliance without demonstration because the location or design of the induction system can easily preclude the need for a demonstration, and the demonstration implied by the requirement could seriously damage rotors and structural components of the rotorcraft and would be unnecessarily costly. The proposal expressed the importance of insuring that foreign objects will not be ingested, by reason of design or location, during certain ground operations. It was not intended, of course, to result in engine damage during a showing of compliance with the requirement. The requirement will in no way prevent the applicant from taking whatever precautions he deems necessary to prevent ingestion at the time he shows compliance with this requirement. If the precautions taken are permanent and prevent ingestion, it should be possible to find that compliance has been achieved without the necessity of conducting an actual operation.

The second comment, made with respect to proposed § 6.462, requested that reference to, and requirements for, supercharged engines be made in paragraph (a), and that the requirements of paragraph (b), for ice protection of turbine engines, be deleted. The provisions of paragraph (a) cover reciprocating engines and were carried into the proposal unchanged from the presently effective rules. The reasons advanced for introducing supercharger requirements are apart from any consideration contained in the draft release and raise no substantive issue which should or could be treated within the framework of this regulatory action. The proposal to add provisions concerning turbine engine ice protection has the purpose of preserving the operational integrity of the engine which is required by presently effective § 13.210(c) and places in more general terms the applicability to turbine engines of the already existing requirement that the engine air induction system shall incorporate means for the prevention and elimination of ice accumulations. The requirement has been revised to clarify the purpose of retaining the previously established capability of the engine to operate in icing conditions, when the engine is installed in the rotorcraft.

In connection with the proposed ice protection requirement, an additional comment was made that the proposal was unclear because of reference made therein to rules in other parts. The Agency feels that the requirement as proposed is made sufficiently explicit by drawing attention to related rules in other parts, and thereby eliminating any possible necessity for repeating those rules in Part 6.

A comment was made with respect to proposed § 6.463(b), that the phrase, "if significant traps exist," should be inserted because the proposed wording was all inclusive and unnecessarily stringent. The agency concurs and the requirement has been revised accordingly.

10. Section 6.485 *Lines and fittings.* The currently effective provisions of § 6.485 set forth requirements for flammable fluid lines and fittings in areas subject to engine fire conditions. These requirements do not take into account that turbine engines present a greater area of hot surface than reciprocating engines and that leaking flammable fluid can easily ignite upon contact with the hot surface. Experience with turbine-powered transports shows that fluid leaks do occur occasionally and can reasonably be expected to occur as well in rotorcraft type certificated in accordance with Part 6. The requirements of present § 6.463(b)(2) (amended § 6.463(d)) for separation of exhaust system and fuel system components establishes a concept of fire prevention which must be retained in the case of turbine engine installations if a comparable level of safety is to be achieved. Section 6.485 is, therefore, being amended by adding a requirement that lines and fittings carrying flammable fluid be located or shielded to prevent fluid leakage on surfaces hot enough to ignite the fluid. It is also being required that flammable fluid from drains and vents be discharged clear of the induction system air inlet.

One comment was made on the proposal to amend § 6.485, expressing concern that the requirement as proposed might not state clearly the fact engine lines and fittings are excluded from applicability of the rule. The provision of the present rule which states, "The provisions of this paragraph shall not apply to those lines and fittings which form an integral part of the engine" is retained. The Agency does not agree that the rule is not clear and explicit, and feels that the concern expressed arises only because the new provision appeared in the draft release after the statement of exclusion. The requirement has been revised, therefore, by reversing the order of appearance of the two provisions.

11. Sections 6.604 and 6.714 *Powerplant instruments; powerplant limitations.* Section 6.1(g)(2)(ii) defines takeoff power for turbine engines in terms of the maximum conditions of engine rotor shaft rotational speed and gas temperature approved for normal takeoff. Section 6.1(g)(4) defines gas temperature as the temperature of the gas stream obtained as indicated in the approved engine specification. Gas temperature is a limiting condition on the development of power and is limited itself by engine operating limitations. Sections 6.604 and 6.714 are deficient in not requiring a gas temperature indicator and the establishment of gas temperature limits. These requirements are, therefore, being added to these sections.

Turboshaft engines used in rotorcraft are capable of producing brake horsepower substantially in excess of the maximum rating or that which the rotor drive system is designed to absorb. Adherence to gas temperature and r.p.m. limitations will not, in all cases, prevent excess brake horsepower. To prevent adverse effects upon rotorcraft and engine structure, and flight characteristics, it was believed necessary to establish a maximum limit upon brake horsepower. This limit would require means to be provided for the pilot to determine that the brake horsepower limit is not being exceeded. It was proposed, therefore, to amend § 6.714 to require that brake horsepower limitations be established for takeoff and maximum continuous operation and to amend § 6.604 by adding a requirement for means to enable the pilot to determine the brake horsepower.

Several comments were made on this proposal. None of the comments took issue in principle but all of them contended that torque and torque limitations were the significant factors to be considered, rather than brake horsepower. The Agency concurs and the requirements involved have been revised accordingly by employing the term "torque" in place of "brake horsepower." In so doing, it has been necessary to consider the provisions of presently effective § 6.250(f), pertaining to design torque and torque limitations. For consistency with these provisions and the terms of the draft release, the amendments being made for torque limitation and indication will be applicable to rotorcraft the main rotors of which are driven by turboshaft engines. The torque upon which a limit is established is that which the rotor drive system is designed to transmit or the torque which the main rotor assembly is designed to withstand in complying with the provisions of § 6.250(f), whichever is lesser, if this torque is less than the maximum which the engine is capable of exerting and a torque limiting device is not provided in the transmission system.

Interested persons have been afforded an opportunity to participate in the making of this amendment (27 F.R. 12224), and due consideration has been given to all relevant matter presented.

This amendment is subject to the FAA Recodification Program announced in Draft Release No. 61-25 (26 F.R. 10698). This recodification, however, will not result in any substantive change in the rules as adopted herein.

In consideration of the foregoing, Part 6 of the Civil Air Regulations (14 CFR Part 6, as amended) is hereby amended as follows, effective November 14, 1963:

1. By amending § 6.111 to read as follows:

§ 6.111 Takeoff.

(See also §§ 6.116, 6.740, 6.742, and 6.743.)

(a) The takeoff shall be demonstrated at forward center of gravity, and using takeoff power and takeoff r.p.m.

(b) The takeoff shall be made in a manner such that a landing can be made safely at any point along the flight path in case of an engine failure and shall not require an exceptional degree of skill on the part of the pilot or exceptionally favorable conditions.

(c) Compliance with the provisions of paragraph (b) of this section shall be determined over the range from standard sea level conditions and maximum certificated weight to the maximum altitude capability of the rotorcraft but which need not be greater than 7,000 feet and at weights selected by the applicant.

(d) Pertinent information concerning the takeoff weights and altitudes shall be specified in the performance information section of the Rotorcraft Flight Manual. Information concerning the takeoff procedure, including the type of takeoff surface and appropriate climbout airspeeds, shall be specified in the operating procedures section of the Rotorcraft Flight Manual.

2. By amending § 6.113 by redesignating paragraph (c) as paragraph (d), and by amending paragraph (b) and adding new paragraph (c) to read as follows:

§ 6.113 Minimum operating speed performance.

* * * * *

(b) For reciprocating-engine-powered helicopters, the hovering ceiling at maximum weight shall be not less than 4,000 feet under standard atmospheric conditions and under operating conditions prescribed in paragraph (a) of this section.

(c) For turbine-powered helicopters, the hovering ceiling at maximum weight shall be not less than 2,500 feet pressure altitude at a temperature of standard +40° F. and under operating conditions prescribed in paragraph (a) of this section.

§ 6.116 [Amendment]

3. By amending § 6.116 by adding in the first sentence between the words "established" and "together" the words "over the range from standard sea level conditions and maximum certificated weight to the maximum altitude capability of the rotorcraft but which need not be greater than 7,000 feet and a weight selected by the applicant,".

§ 6.121 [Amendment]

4. By amending § 6.121(a) by adding a new sentence at the end thereof to read "It shall be possible to recover safely from a balked autorotative approach to power-on flight."

§ 6.251 [Amendment]

5. By amending § 6.251(c) by adding a new sentence at the end thereof to read "For turbine engines, the limit torque shall be obtained by multiplying the means torque by 1.25."

6. By amending § 6.304 to read as follows:

§ 6.304 Protection.

All parts of the rotorcraft shall be protected against deterioration or loss of strength in service due to weathering, corrosion, abrasion, or other causes, and shall be ventilated and drained where necessary for protection to prevent the accumulation of corrosive, flammable, and noxious fluids.

7. By amending § 6.401 by adding a new paragraph (c) to read as follows:

§ 6.401 Engines.

* * * * *

(c) In establishing compliance with the provisions of § 6.120, for rotorcraft incorporating turbine engines, engine combustion flameout shall not occur nor shall compressor stall or surge prevent compliance with the provisions of § 6.120.

8. By amending § 6.427 to read as follows:

§ 6.427 Fuel strainer or filter.

A fuel strainer or filter shall be installed between the fuel tank outlet and the fuel metering device of the engine and shall comply with the following provisions:

(a) The strainer or filter shall incorporate a sediment trap and drain;

(b) The strainer or filter shall be installed in an accessible position;

(c) The screen or filter element shall be easily removed for cleaning;

(d) If an engine-driven fuel pump is incorporated, the strainer or filter shall be located between the fuel tank and the pump; and

(e) Provision shall be made to maintain automatically the fuel flow to turbine engines when ice-clogging of the strainer or filter occurs, unless means are incorporated in the fuel system to prevent the accumulation of ice particles on the strainer or filter.

9. By amending § 6.450 to read as follows:

§ 6.450 General.

The powerplant cooling system shall be capable of maintaining the temperatures of powerplant components and engine fluids within the temperature limits established for such components and fluids, under all surface (ground or water) and flight operating conditions. (For cooling system instruments, see §§ 6.604 and 6.734.)

10. By amending § 6.451 to read as follows:

§ 6.451 Cooling tests.

(a) *General.* Compliance with the provisions of § 6.450 shall be demonstrated by test under critical surface (ground or water) and flight operating conditions. If the tests are conducted under conditions which deviate from the maximum anticipated air temperature (see paragraph (b) of this section), the recorded powerplant temperatures shall be corrected in accordance with the provisions of paragraphs (c) and (d) of this section. The corrected temperatures determined in this manner shall not exceed the established limits. In the case of reciprocating engines, the fuel used during the cooling tests shall be of the minimum grade approved for the engines involved, and the mixture settings shall be those normally used in the flight stages for which the cooling tests are conducted. The test procedures shall be as outlined in § 6.452.

(b) *Maximum anticipated air temperature.* The maximum anticipated temperature (hot-day condition) shall be 100° F. at sea level, decreasing from this value at the rate of 3.6° F. per thousand feet of altitude above sea level until a temperature of −69.7° F. is reached above which altitude the temperature shall be constant at −69.7° F.

(c) *Correction factor.* Temperatures of all powerplant components and engine fluids, except cylinder barrels, for which temperature limits have been established shall be corrected by adding the difference between the maximum anticipated temperature and the temperature of the ambient air at the time of the first occurrence of the maximum component or fluid temperature recorded during the cooling test, unless a more rational correction is shown to be applicable.

(d) *Correction factor for cylinder barrel temperatures.* Cylinder barrel temperatures shall be corrected by adding 0.7 of the difference between the maximum anticipated temperature and the temperature of the ambient air at the time of the first occurrence of the maximum cylinder barrel temperature recorded during the cooling test, unless a more rational correction is shown to be applicable.

11. By adding a new § 6.452 to read as follows:

§ 6.452 Cooling test procedures.

(a) *General.* The cooling tests shall be conducted with the rotorcraft in the configuration and operating under the conditions which are critical relative to cooling during each stage of flight.

(b) *Temperature stabilization.* For all stages of flight, temperatures shall be stabilized under conditions from which entry is made into the stage of flight for which a test is conducted, except when the entry condition normally is not one during which component and engine fluid temperatures would stabilize. In such case, operation through the full entry condition shall be conducted prior to entry into the stage of flight for which the test is conducted in order to allow temperatures to attain their natural level at the time of entry. During the takeoff cooling test of helicopters, the climb at takeoff power shall be preceded by a period of operation at hover during which the powerplant component and engine fluid temperatures are stabilized. A temperature shall be considered stabilized when its rate of change is less than 2° F. per minute.

(c) *Duration of test.* Cooling tests for each stage of flight shall be continued until one of the following conditions is fulfilled:

(1) Component and engine fluid temperatures stabilize;

(2) The stage of flight is completed; or

(3) An operating limitation is reached.

12. By amending § 6.460 to read as follows:

§ 6.460 General.

The engine air induction system shall supply air as required by the engine when the rotorcraft is operated under all intended operating conditions and maneuvers.

13. By amending § 6.461 to read as follows:

§ 6.461 *Air induction.*

The following provisions shall apply to air induction systems:

(a) Cold air induction systems shall open completely outside the cowling unless the emergence of backfire flames is prevented;

(b) If fuel accumulation is possible, air induction systems shall be provided with drains which discharge fuel clear of the rotorcraft and out of the path of exhaust flames; and

(c) Operation of turbine engines from idle to the start of takeoff shall not result in pebble ingestion into the induction air inlet when the rotorcraft is operated on a pebble bed at least 1½ inches deep, consisting of pebbles which will pass through ½-inch mesh screening but not through ⅛-inch mesh screening, and spread over an area which extends horizontally 5 feet beyond tips of the main rotor.

14. By amending § 6.462 to read as follows:

§ 6.462 **Induction system protection from ice.**

(a) *Reciprocating engines.* (1) The engine air induction system shall incorporate means for the prevention and elimination of ice accumulations. Unless it is demonstrated that this can be accomplished by other means, compliance with the following heat rise provisions shall be demonstrated in air free of visible moisture at a temperature of 30° F. when the engine is operating at 75 percent of its maximum continuous power.

(2) Rotorcraft equipped with sea level engines employing conventional venturi carburetors shall have a preheater capable of providing a heat rise of 90° F.

(3) Rotorcraft equipped with sea level engines employing carburetors which embody features tending to reduce the possibility of ice formation shall be provided with a sheltered alternate source of air. The preheat supplied to this alternate air intake shall be not less than that provided by the engine cooling air downstream of the cylinders.

(4) Rotorcraft equipped with altitude engines employing conventional venturi carburetors shall have a preheater capable of providing a heat rise of 120° F.

(5) Rotorcraft equipped with altitude engines employing carburetors which embody features tending to reduce the possibility of ice formation shall have a preheater capable of providing a heat rise of 100° F., except that if a fluid deicing system is used the heat rise need not be greater than 40° F.

(b) *Turbine engines.* The engine as installed shall be capable of operation throughout the flight power range without adverse effect on engine operation or a serious loss of power or thrust under the icing conditions specified in § 13.210(c) of Part 13 of this chapter.

15. By amending § 6.463 to read as follows:

§ 6.463 **Exhaust system.**

The following provisions shall apply to exhaust systems:

(a) Provision shall be made for thermal expansion of manifolds and pipes;

(b) Provision shall be made to prevent local hot spots;

(c) Exhaust gases shall be discharged clear of the engine air intake, fuel system components, and drains;

(d) Exhaust pipes shall not be located adjacent to or under the carburetor or fuel system parts unless such parts are protected against leakage;

(e) Exhaust gases shall not impair pilot vision at night due to glare; and

(f) If significant traps exist, turbine engine exhaust systems shall be provided with drains discharging clear of the rotorcraft in normal ground and flight attitudes to prevent the accumulation of fuel after the failure of an attempted engine start.

§ 6.485 **[Amendment]**

16. By amending § 6.485 by inserting between the second and last sentences of paragraph (a) a new sentence to read "Lines and fittings carrying flammable fluid shall be located or shielded to prevent fluid leakage on surfaces hot enough to ignite the fluid.", and by adding at the end of paragraph (b) a new sentence to read "Flammable fluid from drains and vents shall be discharged clear of the induction system air inlet."

17. By amending § 6.604 by adding new paragraphs (n) and (o) to read as follows:

§ 6.604 **Powerplant instruments.**

* * * * *

(n) Gas temperature indicator for each turbine engine.

(o) For each turboshaft engine, means to enable the pilot to determine the torque if a torque limitation is established in accordance with the provisions of § 6.714(d).

18. By amending § 6.714 by deleting from the first sentence the parenthetical letter "(c)" and inserting in lieu thereof "(d)", by adding to paragraph (a) a new subparagraph (5), by adding to paragraph (b) a new subparagraph (3), and by adding a new paragraph (d) to read as follows:

§ 6.714 **Powerplant limitations.**

* * * * *

(a) *Takeoff operation.* * * *

(5) The permissible gas temperature for turbine engines over the range of operating and atmospheric conditions for which certification is sought.

(b) *Continuous operation.* * * *

(3) The permissible gas temperature for turbine engines over the range of operating and atmospheric conditions for which certification is sought.

* * * * *

(d) *Torque.* For rotorcraft the main rotors of which are driven by turboshaft engines, the torque which the rotor drive system is designed to transmit or the torque which the main rotor assembly is designed to withstand in complying with the provisions of § 6.250(f), whichever is lesser, if this torque is less than the maximum which the engine is capable of exerting and a torque limiting device is not provided in the transmission system.

(Secs. 313(a), 601, 603; 72 Stat. 752, 775, 776; 49 U.S.C. 1354, 1421, 1423)

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N. E. HALABY,
Administrator.

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